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Energy Research Abstracts

Abstracts 12273–13933

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents. Please note that beginning with the January 1991 issue, *ERA* does not cover nonreport literature.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Robert W. Rutkowski

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
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- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

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The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

(1) (2) (3)

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

(4) (6) (7) (12) (13) (16) (17)

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

(9)

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

(8) (10) (11)

(18) Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

(20)

(9)

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

(5) (14) (15) (9)

(19) Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in 30m^2 air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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Vienna, Austria

NTIS U.S. Department of Commerce
National Technical Information Service
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Springfield, VA 22161

OSTI U.S. Department of Energy
Office of Scientific and Technical Information
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How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

Report Number Index
Technical report literature is indexed by the alpha-numerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–
T1 15:18494 NTIS, OSTI E 1.99: DE89007246 MF-411

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

12273 (ETDE/JP-mf–1759127) **Commemorataive symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.: 12th meeting for joint technology of production and utilization and utilization technology.** Coal Mining Research Centre, Tokyo (Japan). Aug 1990 316p. (In Japanese). Order Number DE91759127. Source: OSTI; NTIS (US Sales Only).

This is a commemorative symposium on coal technology for the 30th anniversary of the founding of the Coal Mining Research Center, Japan. As a policy subject to promote coal utilization, abatement of environmental load is brought up. When the thermal efficiency increases from 37 to 43%, CO_2 is reduced by 15%. As one of the steps toward it, a 50,000kW class demonstration plant for the normal pressure fluidized bed combustion is now under development (small and medium size ones have already been commercialized). Furthermore, aiming at a 12% decrease of CO_2, development of the pressurized fluidized bed combustion combined cycle power generation has just started. Also aiming at a 15% reduction of CO_2, the entrained bed coal gasification combined cycle power generation is now being developed at a pilot plant. Low pollution by such methods has already been made practicable as the wet type flue gas desulfrization, the catalytic reduction flue gas denitrification and the multistage combustion. On the other hand, the dry type simultaneous desulfrization and denitrification technology is under development. Concerning the coal utilization technology, improvement of CCS (coal cartridge system), CWM (coal water mixture), etc. is now in progress. Coal technology developments on the following items are also published in the book: production, handling, combustion, gasification, effective use of coal ash, coal direct utilization for iron-ore smelting. 41 refs., 197 figs., 104 tabs.

12274 (ETDE-mf–1759416) **Programme report - coal technology. Report on coal technology promotion.** Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1990 70p. (In German). Order Number DE91759416. Source: OSTI; NTIS (US Sales Only).

The main objectives of coal technology promotion by the Federal Minister for Research and Technology (BMFT) are to secure national energy supply at cost-effective conditions, to produce and use coal in a way compatible with ecological requirements, and to improve the conditions for workers and the environment. These objectives are highlighted by photographs, diagrams and tables and focus on mining technology, less pollutive black-coal-fuelled power plants, coal upgrading and the programme 'Labour and technology' (accident prevention, abatement of hazardous dusts, labour medicine research). Project examples demonstrate mining technology (new cutting techniques, transport technology, automation, underground gasification, microbial processing), coal conversion (coal liquefaction, coal gasification, combustion reserach, primary NO_x reduction), and heat and power technology (rational coal utilization, combined power plants, hot-gas treatment plants, high-temperature gas turbines, two-fuel steam power plants). (HWJ).

0103 Preparation

Refer also to citation(s) 12364, 12377, 12902, 12903

12275 (CONF-900858–, pp. 89-95) **The demonstration of deep-cleaning capabilities for supplying premium coal-based fuels.** Maxwell, R.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Energy International has directed a series of deep-cleaning demonstration tests with the baseline Upper Elkhorn No. 3 type coal by a number of representative contractors. These cleaning test projects have convincingly shown that various levels of deep-cleaning can be effectively attained in existing pilot scale operations using different types of beneficiation technologies to deliver tonnage quantities of fuel product. Each of the demonstrated capabilities is of sufficient technical maturity to be commercialized when economic opportunities for the fuel products warrant. The coal cleaning processes investigated include: conventional heavy media separation; small heavy media cone; conventional froth flotation; microbubble column flotation; acid washing (post-heavy media); and T-process agglomeration (Otisca).

12276 (CONF-900858–, pp. 159-165) **Pelleting/reslurrying as a means of distributing and firing clean coal.** Conkle, H.N.; Barrett, R.E. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Low ash, clean coal offers an alternative to petroleum liquids and natural gas as a fuel for commercial boilers, furnaces, and heat engines. It is expected that those units which are coal fired will use dry ultrafine coal powder or coal-water slurries. However, problems associated with storing, handling and transporting clean coal in both the dry powder and in the slurry form exist. This program will develop technology for: Producing clean coal pellets from highly beneficiated coal (in the form of filter cake); Storing, handling, and transporting the pellets to the user sites; and reslurrying the pellets to form coal-water slurries with properties suitable for pumping, atomizing, and firing. Should additives be necessary to produce acceptable slurries, they will, if feasible, be incorporated at the time of pellet formulation. Thus, all that will remain at the user site will be to add water and mix. The project involves the following 10 tasks: acquire beneficiated coal products; identify reconstitution technology; prepare & test small batches; prepare bench/pilot scale quantities of pellets; evaluate storage characteristics of pellets; evaluate handling characteristics of pellets; evaluate transportation characteristics of pellets; reslurry pellets & evaluate CWF's; utilization/commercialization of slurry technology; and prepare additional wet filter cake. Each is discussed below.

12277 (CONF-900858–, pp. 166-173) **Mulled coal: A new fuel form.** Maxwell, R.C. (Energy International Corp., Pittsburgh, PA (USA)); Davis, B.E.; Henry, R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The proposed technical approach to the overall problem of handling fine beneficiated coal is to prepare a new fuel form the authors have termed mulled coal (MC). This can utilize coal as a wet filter cake or as a powder which has been beneficiated by any conventional fine coal cleaning method. The objective is to prepare a coal-water mixture with a solids loading and the rheology necessary for pumping and handling at low shear rates. But also, with sufficient thickness to insure long-term stability by limiting Stoke's velocity for the vibrational stresses expected to be developed during typical transportation modes and storage methods. There will be several keys to the successful evolution of this interesting concept. These keys include: effective formulation and preparation of the mulled coal fuel form and the low cost atomizable fuel form at the user application; low cost equipment and procedures for processing as well as the storage, transportation, and handling; capability to simulate the storage, transportation, and handling conditions for developmental testing purposes with meaningful reference basis; appropriate organization, experience, and facilities to implement this development. The project plan to implement the

development of mulled coal is described under the following subtasks: selection of chemical additives; mulled coal processing; simulated transportation testing; handling tests; storage tests; and dilution and atomization testing.

12278 (CONF-900858–, pp. 241-248) **Comminution employing freezing temperature pretreatments.** Yen, Shingchung (Southern Illinois Univ., Carbondale (USA)); Hippo, E.J. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The goal of this project is to develop a methodology that will lead to the establishment of an effective, efficient technique for ultrafine grinding of coal. To be more specific, the authors believe that the key for a successful coal grinding strongly dependent upon the change of the brittleness of coal under a freezing temperature pretreatment. Furthermore, acryogenic grinding process may provide the basis for the development of advanced technologies involving the separation of the pyritic minerals from coal. These advanced techniques may include the selective liberation of finely dispersed minerals without the need for ultrafine micronization of the coal. The specific objectives of the program are to: (1) determine the effect of low temperature pretreatments liquid nitrogen, dry ice, and dry ice/acetone; on the microfracture development along the coal/pyrite interface and on the fracture resistance (brittleness) of coal; (2) determine the fracture resistance of coal under different low temperature pretreatments; (3) determine the relationships between the fracture resistance of coal and the effectiveness of a grinding process; (4) determine the effect of the frozen coal grinding on the pyrite liberation; (5) evaluate factors which might effect process design, scale-up, and economics; and (6) make a first pass economic assessment of the process.

12279 (CONF-900858–, pp. 249-258) **Development of the electroacoustic dewatering (EAD) process for fine/ultrafine coal.** Chauhan, S.P. (Battelle, Columbus, OH (USA)); Menton, R.; Senapati, N.; Criner, C.; Kim, B.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Battelle, is developing the Electroacoustic Dewatering (EAD) process for the dewatering of fine and ultrafine coals. The EAD process capitalizes on the adaptation of synergistic effects of electric and acoustic fields to commercial coal dewatering systems, such as belt presses. This paper provides recent results on laboratory-scale EAD tests on coal predewatered to about 50 percent moisture level. The goals for the product cake moisture content for this project -100 mesh: 10-20 percent; and -325 mesh: 25-30 percent.

12280 (CONF-900858–, pp. 259-266) **High gravity centrifuge for fine coal dewatering.** Smith, L.B. (Coal Technology Corp., Bristol, VA (USA)); Wolfe, R.A. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objectives of this project are to develop a broad base of data on new high speed batch type centrifugal dryer technology and to identify, confirm and optimize the technical and economic advantages which the new system can provide to the coal industry and to coal consumers. More than 20 major independent variables govern the process and apparatus involved in the operation of the high gravity, batch type centrifugal dryer. The project employs a prototype centrifuge installed in 1988 at a Southwest Virginia coal preparation plant. During earlier testing of this machine, a less than ideal, but nevertheless operational, balance of the levels of the more than twenty principal independent variables involved was arrived at. To save time the preliminary development work employed an evolutionary operational testing (EVOP) format. It was found during this period that a real-time data collection and logging system would be necessary to further refine the process and make it ready for commercialization. The first activity in the current DOE project, was to develop and test the real-time data collection and logging systems. The test program includes: tests of non-blinding filter; tests of general feasibility of the process; tests of a variety of coals; and optimization tests of 6 principal subsystems. Finally, an installation design and flow sheet will be developed for an existing preparation plant and both capital and operational expense for the dryer systems will be projected.

12281 (CONF-900858–, pp. 267-274) **Future research needs of western coal.** Grimes, R.W.; Cha, C.; Sheesley, D. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Sufficient quantities of clean western coal are available to meet the energy demands of the United States for many decades. However, the use of western coal is not without problems. The objective of this work has been to identify advanced processes for beneficiation of western coals for the purpose of improving the market potential of these fuels. The paper describes western coal characteristics; criteria for upgrading western coal; current coal preparation technologies; and developmental coal preparation technologies. The paper concludes drying is the best technology for upgrading western coal and recommends areas for further research.

12282 (CONF-900858–, pp. 276-282) **An update on the DOE/PETC [Department of Energy/Pittsburgh Energy Technology Center] coal preparation process research facility.** Klima, M.S. (Pittsburgh Energy Technology Center, PA (USA)); Mazzocco, N.J.; Killmeyer, R.P. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The U.S. Department of Energy (DOE) has recently begun upgrading the Coal Preparation Laboratory at the Pittsburgh Energy Technology Center (PETC) to provide a bench-scale (100 to 500 pounds per hour) coal preparation research facility for continuous testing of a variety of advanced fine-coal cleaning processes. It will provide a much needed missing link not only for the scaleup of in-house fine-coal-cleaning research, but also for the preparation of specification feeds for researching DOE coal utilization technologies (e.g., liquefaction, combustion, etc.) The Coal Preparation Process Research Facility (CPPRF) will also provide a means for continuing development on contracted research and for conducting cooperative testing with industry. This paper will provide a brief overview of the CPPRF including its various functions, design, flow schemes, control strategy, and environmental and safety features.

12283 (CONF-900858–, pp. 283-289) **The sonic enhancement of physical coal cleaning.** Buttermore, W.H. (Iowa State Univ., Ames (USA)); Slomka, B.J.; Dawson, M.R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. DOE Contract W-7405-ENG-82. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Recent studies at the Ames Laboratory evaluating the use of sonic energy for the enhancement of physical coal cleaning have focused on the removal of hydrophilic materials from oxidized samples of coal prior to separation by surface-controlled processes such as flotation or oil agglomeration. Results of Hallimond tube flotation tests indicate that sonication can restore floatability to oxidized Illinois No. 6 coal. In other related studies, it was found that sonication can restore the hydrophilicity and thereby depress the flotation response of oxidized pyrite samples. Additional results of desliming tests indicate that sonication can significantly reduce the ash content and improve the flotation response of Illinois No. 6

coal, if the coal is rinsed following sonication to remove dislodged material. In other studies, it was determined that the separation distance of radiator surfaces in a 10-kHz sonic treatment apparatus can be increased to accommodate much larger samples of coal with improved performance in removal of clay minerals and significant reductions in operating cost.

12284 (CONF-900858–, pp. 290-297) **Fine coal cleaning with advanced magnetic enhancement technology.** Hwang, J.Y. (Michigan Technological Univ. (USA)). USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

An effective magnetic separation for coal cleaning requires selective magnetic enhancement of coal associated minerals. This study shows that the enhancement can be achieved with a recently developed magnetic reagent technology. Ash-forming mineral matter, pyritic sulfur, and possibly organic sulfur can all be significantly reduced with this approach. The fundamentals of the magnetic reagent technology and the coal cleaning results are described and discussed.

12285 (CONF-900858–, pp. 298-305) **Engineering development of advanced froth flotation pyrite liberation study and round-robin flotation report.** Josephs, L.L. (ICF Kaiser Engineers, Inc., Pittsburgh, PA (USA)); Ferris, D.D. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

ICF Kaiser Engineers (ICF KE) was contracted by United States Department of Energy, Pittsburgh Energy Technology Center to perform a project entitled Engineering Development of Advanced Physical Fine Coal Cleaning Technologies - Froth Flotation. The objective of the project is to develop froth flotation coal beneficiation technology to achieve maximum inorganic pyritic sulfur rejection while simultaneously maintaining very high Btu recoveries. It has been established that removal of inorganic sulfur by physical cleaning before coal combustion is more economical than relying on post combustion cleaning of sulfur as a means of controlling acid rain emissions. Incorporated in this contract were two subtasks that involved the characterization of the raw coal and an advanced flotation round robin. Both of these subtasks resulted in topical reports. Both studies are summarized.

12286 (CONF-900858–, pp. 306-313) **Surface modification of coal in advanced flotation.** Fuerstenau, D.W. (Univ. of California, Berkeley (USA)); Hanson, J.S. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

In order to effectively control acid rain, desulfurization of coal before its combustion has become an important issue. The primary objective of this research project is to develop advanced flotation methods which can reject 90% pyritic sulfur from coal at 90% Btu recovery. Concomitantly, the ash content of the coal is to be reduced to 6% or less. For this project, coal samples were procured from six major US coal seams, but most of the work has been conducted on three base coals (Illinois No. 6, Pittsburgh No. 8 and Upper Freeport PA coal). Investigation of mechanisms for the modification or control of coal and pyrite surfaces prior to fine coal flotation is an important aspect of the project objectives. A second major objective is to investigate the effect of progressive weathering or oxidation of coal and its storage environments covers a period of twelve months on the surface properties of coal and its behavior in the advanced flotation process. The paper describes the characteristics of the base coal samples; flotation studies of the weathered samples film flotation and induction time measurements of weathered samples; and restoring the flotability of weathered coal.

12287 (CONF-900858–, pp. 314-321) **Engineering development of selective agglomeration technology.** Briker, Y. (Alberta Research Council (Canada)); Germain, R.; Ignasiak, L.; Pawlak, W.; Turak, A.; Wong, B.; Ghosh, A.; Hadley, S.; Moro, D.; Sehgal, R.; Humphris, D.; Moore, D.; Blanco, J.; Campbell, R.; Henshaw, W.; Mann, G.; Maxwell, D.; Pinkston, T.; JoUSDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

In April 1989, Southern -Company Services signed a 3.5 year contract with DOE-PETC for generic engineering development of an advanced physical fine coal cleaning technology known as selective agglomeration. Engineering development will include bench-scale process development; component development adaption or modification of existing unit operations; proof-of-concept (POC) module design, fabrication, testing and evaluation; and small commercial facility conceptual design. The information obtained during POC operation will be sufficient to result in a technical and economic design base that can support construction and operation of a small commercial plant. The major goal of the research is to develop selective agglomeration technology to achieve 90% pyritic sulfur removal while operating at Btu recoveries above 90% based on run-of-mine quality coal. This objective will be accomplished in two phases: Phase 1 - bench-scale and component development, and Phase 2 - POC module operation and conceptual design of a small commercial plant. Currently, work is proceeding under Phase 1 (Tasks 1-7) of the project. A review of the status of Tasks 1-7 is presented in this paper. The seven tasks are: project work plan; preliminary conceptual design of 20-t/h semiworks plant; determination of process uncertainties; test plan formulation and coal procurement; bench-scale process testing; unit operations testing; and evaluation of bench-scale and unit operations test results.

12288 (CONF-900858–, pp. 322-328) **Surface control in selective agglomeration for advanced physical coal cleaning.** Morsi, B.I. (Univ. of Pittsburgh, PA (USA)); Chiang, S.H.; Sharkey, A.; Blachere, J. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The overall objective of the project is to develop techniques for coal surface control prior to the advanced physical fine coal cleaning process of selective agglomeration in order to achieve 90% pyritic-sulfur rejection at a Btu recovery greater than 90% based on run-of-mine coal. The surface control is meant to encompass storage, grinding in different environments and media, surface modification during grinding and laboratory beneficiation testing. The project includes the following tasks: (1) Project Planning; (2) Method for Analysis of Samples; (3) Development of Standard Beneficiation Test; (4) Grinding Studies; (5) Modification of Particle Surface; and (6) Exploratory R & D and Support. Three base coals were used in this work: Upper Freeport - Indiana County, PA, Pittsburgh No. 8 - Belmont County, OH, and Illinois No. 6 - Randolph County, IL. The status and results are discussed for tasks 2.5.

12289 (CONF-900858–, pp. 329-335) **Simulation of advanced coal cleaning technologies.** Mock, T.L. (Aspen Technology, Inc., CO (USA)); Gallier, P.W.; Zebula, C.E.; Harrison, K.E. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective of this program is to perform Engineering Design and Analysis of Advanced Physical Fine Coal Cleaning Technologies. The major goal of this work is to provide the simulation tools to modeling both conventional and advanced coal cleaning technologies. This effort is part of a major research initiative aimed at advancing three advanced coal cleaning technologies - heavy-liquid cycloning, selective agglomeration, and advanced froth

flotation through the proof-of-concept level. The commercially available ASPEN PLUS process simulator is being extended to model these advanced coal cleaning processes along with conventional coarse coal cleaning processes. State-of-the-art unit operation and cost models for over thirty coal cleaning devices and related ancillary equipment are being developed. The simulator will be useful a tool to aid process engineers in studying different process designs, evaluate the capital investment operating costs, and determine the optimum process for treating different coals. Much progress has been made in identifying some of the major features to be incorporated into the ASPEN PLUS system for coal cleaning simulation. Activities are underway to implement and test these enhancements to the simulator. In addition, much work has been focused on reviewing, developing, and installing the gravity separation models as the first set of conventional coarse coal cleaning models. The beta test of the ASPEN PLUS system demonstrated that the various components of the coal cleaning simulator are operational and executing properly. The success of the beta test is a major milestone of this program.

12290 (DOE/PC/89908–T5) **Engineering design and analysis of advanced physical fine coal cleaning technologies: Quarterly technical progress report No. 3, April–June 1990.** Gallier, P.W. Aspen Technology, Inc., Cambridge, MA (USA). 15 Jul 1990. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89908. Order Number DE91008945. Source: OSTI; NTIS; GPO Dep.

This project is sponsored by the United States Department of Energy (DOE). The major goal is to provide the simulation tools for modeling both conventional and advanced coal cleaning technologies. This effort is part of a major research initiative by the Pittsburgh Energy Technology Center (PETC) aimed at advancing three advanced coal cleaning technologies – heavy-liquid cycloning, selective agglomeration, and advanced froth flotation through the proof of concept (POC) level. The commercially available ASPEN PLUS process simulation package will be extended to handle coal cleaning applications. Algorithms for predicting the process performance, equipment size, and flowsheet economics of commercial coal cleaning devices and related ancillary equipment will be incorporated into the coal cleaning simulator. This report is submitted to document progress for the third quarterly reporting period, April through June 1990. ICF Kaiser Engineers, Inc is providing coal preparation consulting and processing engineering services in this work and they are responsible for recommending the design of models to represent conventional coal cleaning equipment and costing of these models.

12291 (VTT-OPT–25) **Drying of peat and intensifying the drying.** Jaervinen, T.; Kallio, M. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 115p. (In Finnish). Project KTM-275/881/87. Order Number DE91752993. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

The aim of the peat drying projects was to create a first stage physical model for drying of peat and to increase the absorption of solar radiation by timing the harrowing (turning) of the milled peat layer, by measuring the efficiency of turning and by increasing the insulation potential of the field surface. Both analytical and numerical solutions for calculation of heat and mass transfer were applied in this report. They showed the difficulties of realization of the exact drying model. Additionally, the effects of water table and the unsaturated layer (the production layer) in a peat field, weather conditions and properties of milled layer on peat drying in the simulation chamber for peat field and climatic conditions and in the real production fields are presented. The test results revealed, that the pulling speed off harrow can be increased. Especially the first turning should be timed well. The studies were carried out in the simulation chamber and a thermal imaging radiometer was used on the production field. The increasing of the fields insulation potential was done with the short mole drains towards field ditches. They seemed to work according to visual inspection during rains, but they had no effect on the moisture content of the Sphagnum dominant fields. The unsaturated (production) layer in the ditched and levelled Sphagnum field was thicker than in the Carex-Sphagnum predominant field, where the production was taken place.

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Refer also to citation(s) 12275, 12322, 12355, 12592, 12593, 12637, 12639, 12902, 12903, 13166, 13532, 13533, 13534

12292 (CONF-891130–6) **The effect of limestone on ash behavior in fluidized-bed gasification of coal.** Kline, S.D.; Mason, D.M.; Carty, R.H.; Babu, S.P. Institute of Gas Technology, Chicago, IL (USA). [1989]. 14p. Sponsored by USDOE,. DOE Contract AC21-87MC23283. From 3. international conference on processing and utilization of high-sulphur coals; Ames, IA (USA); 14-18 Nov 1989. Order Number DE91008402. Source: OSTI; NTIS; GPO Dep.

The behavior of coal mineral matter is of interest in fluidized-bed coal gasification and stage combustion because it governs the formation of ash agglomerates that facilitate ash removal from the reactor without excessive loss of carbon as well as deposition on reactor internals and downstream surfaces. The ultimate aim of this research program is to be able to predict quantitatively the behavior of the mineral matter in a fluidized-bed gasifier based on the operating conditions of the gasifier and a minimum analysis of the mineral matter present in the coal feed. In this work, the effects on ash behavior of using limestone as an in-bed sulfur capture agent and of recycling an SO_2-containing stream from the regeneration of a hot-gas cleanup system to the gasifier were investigated. The feed solids, ash discharge, and bed material from a pilot plant test in which limestone was used for sulfur capture were analyzed. Also, tests in a 2-in. ID reactor in which mixtures of limestone and coal char were gasified with steam and air, with and without the addition of SO_2 to the feed gas, were studied. The results indicate that very few conventional coal ash agglomerates were formed, but instead the coal ash became attached to and penetrated the particles containing calcium oxide and calcium sulfide that were formed from the limestone. Sulfur dioxide recycled to the bed was reduced to hydrogen sulfide and absorbed as calcium sulfide with little, if any, other effect on ash behavior. 4 refs., 2 figs., 3 tabs.

12293 (CONF-900402–12) **H_2S removal from fuel gas during coal gasification.** Abbasian, J. (Institute of Gas Technology, Chicago, IL (USA)); Rehmat, A.; Leppin, D.; Banerjee, D.D. Institute of Gas Technology, Chicago, IL (USA). [1990]. 13p. Sponsored by Institute. From 199. national meeting of the American Chemical Society; Boston, MA (USA); 22-27 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology (IGT) has already developed the U-GAS Process to produce fuel gas from coal. The U-GAS process uses a single-stage fluidized-bed reactor efficiently convert any type of coal either run-of-mine or washed, into low- or medium-Btu fuel gas that can be used in industrial plants or utility power plants. (2) The process has been developed during 10 years of testing in a 30 tons of coal per day capacity pilot plant located in Chicago and is currently being commercialized. In a new configuration of the U-GAS process, the U-GAS, One-Step Desulfurization Process, limestone or dolomite is fed into the coal gasifier to capture and remove sulfur compounds from the fuel gas within the gasifier. Under the reducing conditions of the gasifier, limestone reacts with sulfur compounds to significantly reduce the sulfur content of the fuel gas. 16 refs., 6 figs., 2 tabs.

12294 (CONF-900801–41) **An advanced coal gasification desulfurization process.** Abbasian, J. (Institute of Gas Technology, Chicago, IL (USA)); Rehmat, A.; Leppin, D.; Banerjee, D.D. Institute of Gas Technology, Chicago, IL (USA). [1990]. 7p. Sponsored by Ins. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology (IGT) is in the process of developing an advanced coal gasification desulfurization process in which a calcium-based sorbent such as limestone or dolomite is injected into the fluidized-bed gasifier with coal to achieve in-bed desulfurization of coal as it is converted into clean fuel gas. The reactions involving calcium-based sorbents takes place in two steps. In the first step, the desulfurization reaction takes place between hydrogen sulfide and calcium oxide in the reducing zone of the reactor to produce calcium sulfide. The latter subsequently reacts

with oxygen in the oxidizing zone of the reactor to produce calcium sulfate which can be safely disposed of along with the coal ash. This process will reduce the capital requirement for coal gasification plants and provide cost effective alternatives to scrubbers for industrial and utility use of high-sulfur coal. This paper addresses the basic research being conducted at IGT to confirm the viability of this process. 9 refs., 3 figs., 1 tab.

12295 (CONF-900801–42) **Development of the IGT mild gasification process in a 100-pound-per-hour process research unit.** Onischak, M. (Institute of Gas Technology, Chicago, IL (USA)); Gissy, J.; Knight, R.A.; Babu, S.P.; Wootten, J.M.; Duthie, R.G.; Longanbach, J.R. Institute of Gas Technology, Chicago, IL (USA). [1990]. 7p. Sponsored by USDOE,. DOE Contract AC21-87MC24266. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE91008395. Source: OSTI; NTIS; GPO Dep.

The USDOE is sponsoring development of technology for the mild gasification of coal. The Institute of Gas Technology (IGT) mild gasification process incorporates a combined fluidized bed-entrained bed reactor designed to handle all types of coals. The type of coal used and the market available for the char, which constitutes up to 70% of the co-products, are interrelated. The char could be used to produce form coke, utility fuel, gasification feedstock, or low-cost activated adsorbent char. The process could be integrated with a conventional coal preparation plant, using a stream of high-moisture coal fines. Mild gasification of a coking or marginally coking coal could produce a form-coke for the steel industry and foundries and help relieve the shorter in US coke supplies. The development of a mild gasification process at IGT has been supported by the USDOE since September 1987, with the operation of a 100-lb/h capacity isothermal process research unit (PRU) to investigate the effects of operating conditions and to determine the two coals. one from Illinois and one from West Virginia. The PRU results have been used to design a 24-ton/day adiabatic process development unit (PDU). 3 refs., 4 figs., 1 tab.

12296 (CONF-900858–, pp. 176-183) **Molten caustic leaching (gravimelt) system integration.** Meyers, R.A.; McClanathan, L.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objectives of the plant operations task are to operate an integrated MCL test circuit to demonstrate the feasibility of the technology for producing a demineralized and desulfurized coal that meets New Source Performance Standards (NSPS), to test process conditions aimed at lowering costs, and to deliver product coal. These objectives were partially met by the continuous operation of the partially integrated test circuit during a 54-element test matrix that resulted in the production of 3,000 pounds of treated coal. Two high-sulfur, high ash-coals representative of the eastern United States coal production were processed: Pittsburgh No. 8 and Kentucky No. 9. Although mild kiln conditions (371 to 438°C and 1 to 2.5 hours residence time) and low caustic to coal ratios (1:1 to 3:1) were used, the combination of continuous operation and rigorous exclusion of air from the system allowed the production of MCL coal which had product sulfur content was well below NSPS standards, very low carbonate and volatiles loss, and low alkali retention by the product MCL coal. Optimization testing resulted in a product coal containing 0.4 percent sulfur (0.6 lbs SO_2/million Btu) and 0.15 percent ash representing more than 90 percent organic sulfur removal, 95 percent SO_2 reduction from run-of-mine coal, and 91 percent SO_2 reduction from precleaned process feed coal. Test results indicate that a MCL treated coal would possess a heat content of about 14,000 Btu per pound.

12297 (CONF-900858–, pp. 184-191) **Recent improvements in chemical coal cleaning by the molten caustic leaching process.** Markuszewski, R. (Iowa State Univ., Ames (USA)); Chriswell, C.D. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The molten caustic leaching (MCL) process has been demonstrated over several years to be effective in producing low-ash, low-sulfur coals that can meet environmental regulations. In order to make the process more economical, reduce the severity of the processing conditions while still maintaining its effectiveness, and extend its applicability to coals of a wider range of rank, research at the Ames Laboratory has concentrated on improving the chemical cleaning of coal by MCL. So far, there is sufficient evidence accumulated that for most coals, use of sodium hydroxide alone is as effective as the more expensive sodium hydroxide-potassium hydroxide mixtures. Further cost reductions can be achieved by using a modified two-stage leaching procedure, consisting of different temperatures and durations, without losing any desulfurization efficiency. Finally, it has been demonstrated that MCL can be applicable to some lower-rank coals under carefully controlled conditions.

12298 (CONF-900858–, pp. 192-198) **Biologically-mediated leaching of pyrite from coarse coal.** Finseth, D. (Pittsburgh Energy Technology Center, PA (USA)); Olson, G.; Hyman, D.; Hammack, R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Biologically mediated heap leaching for pyrite removal is a strategy proposed to reduce the pyritic sulfur content of high sulfur coals. The method involves placing the high pyrite-content materials on leach pads with an impermeable base and applying a pyrite-oxidizing agent, such as an acidic ferric sulfate solution. In this work this ferric leaching solution is generated in situ by oxidation of indigenous pyrite. The resulting leachate is collected, treated as required, and reapplied-to the heap until the desired amount of pyrite has been removed. To accelerate this pyrite oxidation process, indigenous iron and sulfur oxidizing bacteria are encouraged to colonize the heap. The ultimate goal is total pyrite removal so the coal can be utilized without requiring additional cleaning. This small-scale study was conducted in the Bureau of Mines heap leaching test facility. This facility accommodates two 25-ton heaps, one in an indoor environment and one outdoors. The facility is equipped with a 48-channel data acquisition computer linked to a mainframe computer, compressed air-powered fluid circulation pumps, two 500 gallon and one 1,500 gallon liquid storage tanks, and a twin in-line system (ILS) water treatment device. This work describes a heap constructed from 46,000 pounds of coal that was leached from July 17, 1987 to August 18, 1988 in an indoor laboratory setting. The coal was run-of-mine stoker size Pittsburgh seam coal from Philippi, West Virginia. The cumulative amount of sulfate and iron removal, determined from leachate analysis, is presented as a function of leaching time.

12299 (CONF-900858–, pp. 211-216) **Development of genetic methods for the study of DBT⁺ [dibenzothiophene] phenotypes in Pseudomonas spp.** Krawiec, S. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Dibenzothiophene (DBT) has commonly been used as a model of what is considered an especially refractory form of organic sulfur. The sulfoxide/sulfone/sulfonate/sulfate pathway (often called the 4S pathway) was postulated as a means by which DBT might be metabolized. Observations from a number of laboratories during the past year and a half have demonstrated that various Pseudomonas spp., a Brevibacterium sp., and Rhodococcus rhodochrous have the capacity to metabolize DBT to o,o′-biphenol, 2′-monohydroxybiphenyl, biphenyl, or some uncharacterized products. In this report, an assay is briefly described that allows bacteria to be screened for the ability to convert DBT to dibenzosulfone, o,o′-biphenol, or 2′-monohydroxybiphenyl. Subsequently,

the development of methods by which genes for oxidation of DBT to o,o′-biphenol might be cloned in vivo is described. Finally, preliminary results with emission spectroscopy–a technique that might allow investigators to monitor the conversion of DBT to characteristic oxidized products in large batch cultures–are presented.

12300 (CONF-900858–, pp. 226-233) **Microbial activity on model coal organosulfur compounds.** Lepo, J.E. (Univ. of Mississippi, University (USA)); Purdy, R.F.; Ward, B. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Microorganisms offer a potential for the selective removal of organic sulfur from coals. The compound dibenzothiophene (DBT), which is a common component of crude oils, is taken to reflect structural similarity to organic sulfides believed to exist in coals. One means by which microorganisms might catalyze the specific desulfurization of DBT (and perhaps of similar structures in coals) is by oxidative cleavage of the C-S-C bonds. A reaction sequence has been proposed in which the sulfide is oxidized to DBT-sulfoxide, DBT-sulfone, and ultimately to the sulfur-free parent compound plus free sulfate ion. This desulfurization sequence has been referred to as the 4S pathway, with reference to the different sulfur species involved. The objectives for the research described here were to isolate from natural environments bacteria that exhibited metabolic activity on either DBT or DBT-sulfone, with evidence of desulfurization activity reflected as production of sulfur-free products (e.g., the 4S products, 2,2′-biphenol or 2-phenylphenol) and possibly free sulfate ion. Different screening and assay methods were tested for their utility in detecting and measuring 4S activity. The authors report here the results of the initial screening assays and features of the biodegradation of the model compounds, DBT and DBT-sulfone.

12301 (CONF-900859–1) **U-GAS coal gasification process with in-situ desulfurization.** Rehmat, A.; Abbasian, J.; Lau, F. Institute of Gas Technology, Chicago, IL (USA). [1990]. 21p. Sponsored by USDOE, Was. DOE Contract AC21-87MC24266. From 7. U.S./Korea workshop on coal utilization technology meeting; Pittsburgh, PA (USA); 26-31 Aug 1990. Order Number DE91008387. Source: OSTI; NTIS; GPO Dep.

Calcium based sorbents such as limestone and dolomite have been used in conjunction with the U-GAS coal gasification process for in-situ capture of sulfur present in the coal. Under the reducing conditions of the gasifier, these sorbents react with sulfur compounds to form calcium sulfide. As a unique feature of the U-GAS process, the calcium sulfide could be further reacted with air in the ash discharge zone to form calcium sulfate, which is environmentally acceptable for disposal directly from the gasifier along with the agglomerated ash. The Institute of Gas Technology (IGT) has conducted considerable testing in this area under different programs. The suitability of dolomite as in-situ sulfur capturing agent has been verified in U-GAS process using high-sulfur Pittsburgh coal. The gasification tests were conducted at 1850°F in pressure ranges of 100 to 450 psig. The kinetics of the reaction between calcium based sorbents and hydrogen sulfide at these gasification conditions have been derived separately using a thermogravimetric technique. Effect of temperature, pressure, and particle size on the reaction rate were also included in these latter tests. Furthermore, the operating conditions and the type of sorbents suitable for achieving maximum calcium conversion to calcium sulfate during the oxidation step of the process have also been identified. 9 refs., 8 figs., 10 tabs.

12302 (CONF-900859–2) **Development of the IGT mild gasification process: A status report.** Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)); Knight, R.A.; Onischak, M.; Wootten, J.M.; Duthie, R.G.; Longanbach, J.R. Institute of Gas Technology, Chicago, IL (USA). [1990]. 15p. Sponsored by USDOE, Washington, DC (USA); Institute of Gas Technology, Chicago, IL (USA). DOE Contract AC21-87MC24266. From 7. U.S./Korea workshop on coal utilization technology meeting; Pittsburgh, PA (USA); 26-31 Aug 1990. Order Number DE91008386. Source: OSTI; NTIS; GPO Dep.

Under US DOE sponsorship, a project tram consisting of the Institute of Gas Technology (IGT), Peabody Holding Company, Inc., and Bechtel Group is developing a process for mild gasification of coal in a 100 lb/h-capacity isothermal process research unit at IGT in Chicago. The IGT process is capable of converting all types of coals to value-added co-products which can open new markets for the US coal industry. Tests results with Illinois and West Virginia coals show yields of char, oils/tars, and fuel gas to be in the range of 60–76%, 18–30%, and 5–15%, respectively. The IGT mild gasification process incorporates an integrated fluidized/entrained bed reactor with heat supplied indirectly by a combination of char and gas recycle. The reactor is capable of processing all types of coals. The use of mild operating conditions, ambient pressures, and continuous operation in closed reactors, combined with the potential value-added benefits from the sale of co-products, offer an economical and environmentally sound approach to advanced coal utilization. The IGT test results demonstrate the effect of coal type and temperature on mild gasification co-product yields and properties, including the fate of heteroatoms, for Eastern caking coals. Preliminary economic analyses confirm the economic viability of mild gasification. 7 refs., 7 figs., 1 tab.

12303 (DOE/MC/24266–2959) **Task 2: Mild gasification technology development process research unit tests using slipstream sampling, February 1988–March 1990.** Knight, R.A.; Gissy, J.; Onischak, M.; Babu, S.P.; Wootten, J.M.; Duthie, R.G. Institute of Gas Technology, Chicago, IL (USA). Jul 1990. 115p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-87MC24266. Order Number DE91002039. Source: OSTI; NTIS; GPO Dep.

Under USDOE sponsorship, a project team consisting of the Institute of Gas Technology (IGT), Peabody Holding Company, Inc., and Bechtel Group is developing a process for the mild gasification of coal in a 100-pound/hour capacity isothermal process research unit (PRU) at IGT in Chicago. The IGT process is capable of converting bituminous coals to value-added co-products that can open new markets for the US coal industry. The conceptual IGT mild gasification process incorporates an integrated fluidized-/entrained-bed reactor supplying heat indirectly by a combination of char and gas recycle. The use of mild operating conditions (1000° to 1300°F), low pressures (<50 psig), and continuous operation in closed reactors, combined with the sale of value-added co-products, offer an environmentally sound and economical approach to advanced coal utilization. The PRU consists of an 8-inch-ID × 8-foot-long fluidized-bed reactor closely coupled to a 4-inch-ID × 13-foot-long entrained-bed reactor. The PRU test results have demonstrated process performance, including the effect of coal type and temperature on mild gasification co-product yields and their properties. The fates of the heteroatoms have also been analyzed. 9 refs., 16 figs., 41 tabs.

12304 (DOE/PC/79917–T6) **NMR investigation of supported metal catalysts for syngas conversion: Final technical report.** Murty, A.N. Grambling State Univ., LA (USA). Dept. of Physics. 1 Nov 1990. 82p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-87PC79917. Order Number DE91007443. Source: OSTI; NTIS; GPO Dep.

Supported metal catalysts, such as those used in indirect liquefaction for synthesis gas conversion, are being studied. It is believed that unpaired electrons and the unfilled d-shells are responsible for the valuable catalytic properties of the transition group metals. The very same characteristics of these metals are responsible for their interesting magnetic properties also. The primary intent of this study is to examine the influence of the metal-support, metal-promoter, metal-adsorbate interactions on the ferromagnetic character of the transition metal cobalt. This report describes the results of our studies on the ferromagnetic character of cobalt dispersed on various supports zeolites, titania, alumina, with and without added promoters. 51 refs., 18 figs., 10 tabs.

12305 (DOE/PC/79930–T5) **Pyrolysis and gasification of coal at high temperatures: Quarterly progress report No. 13, September 15, 1990–December 15, 1990.** Zygourakis, K. Rice

Univ., Houston, TX (USA). Dept. of Chemical Engineering. [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-87PC79930. Order Number DE91008957. Source: OSTI; NTIS; GPO Dep.

The systematic investigation on the effects of pyrolysis conditions and char macropore structure on char reactivity continued. During the past quarter, we concentrated our efforts on studying the reactivity of chars devolatilized in reactive atmospheres and under pyrolysis conditions encountered in mild gasification processes. Pyrolysis and gasification experiments were performed consecutively in our TGA/VMI reactor. After pyrolyzing the coal particles to a final heat treatment temperature of 500 °C, the char reactivity patterns were measured at three temperatures (420, 450 and 500 °C). The lower heat treatment temperatures employed for these experiments (500 °C or close to mild gasification conditions) resulted in more reactive chars. We compared the reactivities of chars pyrolyzed in inert (N_2) and reactive (O_2/N_2) atmospheres in both the kinetic and the diffusion limited regime. Significant differences in the reactivity of these two groups of chars were found in the diffusion limited regime. Finally, we used the microscopy of our thermogravimetric reactor to monitor the structure transformations occurring during pyrolysis with oxygen. Pyrolysis experiments were videotaped and particle swelling, particle ignitions and fragmentation were determined and analyzed using digitized images from these experiments. 5 figs., 1 tab.

12306 (DOE/PC/80509–T14) **Enhanced coal liquefaction by pyrolysis in supercritical fluids: [Final technical reprot].** Paulaitis, M.E.; Klein, M.T.; Sandler, S.I. Delaware Univ., Newark, DE (USA). Dept. of Chemical Engineering. 19 Nov 1990. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-85PC80509. Order Number DE91007434. Source: OSTI; NTIS; GPO Dep.

A fundamental investigation of a novel coal liquefaction process was undertaken which combines pyrolysis and supercritical-fluid solvent extraction. The experimental work consisted of determining: (1) coal pyrolysis reaction pathways, kinetics and mechanisms; (2) equilibrium solubilities of coal-related compounds in supercritical water. Experiments involving model coal compounds (tetralin and 1-methylnaphthalene, phenethyl phenyl ether, 1,3-diphenylpropane, benzyl phenyl ether, benzylamine). 8 refs., 6 figs., 9 tabs.

12307 (DOE/PC/88929–T7) **Scale-up of circulating fluidized bed coal combustors: Technical progress report, ninth quarter, September 1, 1990–November 30, 1990.** Louge, M.Y. Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering. [1990]. 7p. Sponsored by USDOE,. DOE Contract FG22-88PC88929. Order Number DE91008535. Source: OSTI; NTIS; GPO Dep.

Circulating fluidization is a promising technology for designing efficient coal combustors with high solid feed rates. Unfortunately, limited understanding of circulating fluidized beds (CFB) renders design extrapolations from pilot reactors to full-scale plants both empirical and expensive. In particular, the behavior of large-scale units is unclear. This experimental project has been aimed at quantifying the effects of scale-up upon the hydrodynamics of CFB coal combustors. We have constructed a cold CFB facility with the ability to recirculate fluidization gas mixtures of adjustable density and viscosity. Hydrodynamic analogy between the cold bed and a coal combustor is achieved by matching all relevant dimensionless parameters. Several choices of gas composition and particle properties make the cold flow analogous to that in combustors of diameters in the range 0.3 to 1m. Therefore, for the first time, scale-up effects are quantified directly using a single cold flow facility. The scale-up experiments were completed during the two previous reporting periods. By comparing data obtained in these experiments, we have verified the hydrodynamic analogy predicted by the dimensional analysis. In addition, by fluidizing two glass powders of identical characteristics but largely different surface friction coefficients, we have also discovered, to our surprise, that particle frictions affects the flow. In section 2, we describe a simple experiment to measure the static friction coefficient for the three powders that we have used in scale-up study. 9 refs., 3 figs.

12308 (DOE/PC/88940–T8) **Fundamental studies in production of C_2-C_4 hydrocarbons from coal: Progress report No. 9, September 1, 1990–November 30, 1990.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Dec 1990. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88940. Order Number DE91008968. Source: OSTI; NTIS; GPO Dep.

An envelope of parameter values has been experimentally identified in our laboratory, heretofore unexplored, for the catalytic hydrogenation and hydrocracking of coal which leads to yields of $C_2 - C_4$ hydrocarbons in excess of 50 weight percent of the coal, in a direct, single stage process under mild conditions. In this research program, an innovative and highly sophisticated reactor system, designed and constructed by us, will obtain data to define the reaction pathways leading directly from coal to high yields of $C_2 - C_4$ hydrocarbons, and to provide insight into the mechanisms of the conversion reactions. A computer program will be developed to define the maximum yields of C_2, C_3, and C_4 hydrocarbons thermodynamically possible in such a system, as a function temperature, pressure and percent steam in the steam-hydrogen stream to the reactor, for the type of dual-functional catalyst identified as essential to the conversion process. The process will then be optimized for production of each of the hydrocarbons C_2, C_3, and C_4, and for production of olefins among these hydrocarbons.

12309 (DOE/PC/89775–3) **Control of catalytic hydrotreating selectivity with ammonia: [Progress report], October 1, 1990–December 31, 1990.** Satterfield, C.N.; Lee, Chung M. Massachusetts Inst. of Tech., Cambridge, MA (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89775. Order Number DE91008405. Source: OSTI; NTIS; GPO Dep.

Research continues on catalytic hydrotreating control with ammonia. This quarter a detailed study of quinoline and naphthalene was completed. A mixture of quinoline and naphthalene was hydrotreated. The catalyst was a commercial $NiMo/Al_2O_3$. Results showed the hydrodenitrogenation of quinoline is moderately inhibited by ammonia. Ammonia has little effect on hydrogen consumption during the hydrogenation of naphthalene. Ammonia also improved selectivity to tetralin. 3 figs., 1 tab. (SM)

12310 (DOE/PC/89777–T2) **[Enhanced coal hydrogasification via oxidative pretreatment]: Technical progress report, September 1, 1990–November 30, 1990.** Michigan State Univ., East Lansing, MI (USA). Dept. of Chemical Engineering. [1990]. 6p. Sponsored by USDOE,. DOE Contract FG22-89PC89777. Order Number DE91008489. Source: OSTI; NTIS; GPO Dep.

Research on enhanced coal hydrogasification continued. Work during the fifth quarter of the grant period has focused on characterization of both prepared chars and partially reacted chars, and on cyclic oxidation/hydrogasification for overall enhancement of gasification rates. 3 figs., 2 tabs.

12311 (DOE/PC/89781–5) **A novel coal feeder for production of low sulfur fuel: Quarterly technical progress report, October 1, 1990–January 1, 1991.** Khang, S.J.; Lin, L. Cincinnati Univ., OH (USA). Coll. of Engineering. [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89781. Order Number DE91008955. Source: OSTI; NTIS; GPO Dep.

The project objective is to study the feasibility of an advanced desulfurization concept in a coal feeder. It is proposed to construct a novel coal feeder which contains dual screw tubes, the inner tube acting as a coal pyrolizer and the other tube acting as a desulfurizer with hot calcined limestone pellets or other renewable sorbent pellets. In this quarter, the following basic studies have been performed: (1) setting up the dual-screw reactor, (2) determination of the composition of the pyrolysed gas, (3) analysis of sulfur content in coal and char, and (4) swelling study of coal under pyrolysis condition. The preliminary conclusions are: (1) at operating temperatures between 400–500°C, the concentration of H_2S in pyrolyzed gas ranges from 1.6 to 3.2% (by volume), (2) The average molecular weight of pyrolysed gas is about 41, (3) the coal swelling can be significantly reduced when either CaO or $CaCO_3$ particles are mixed with the coal feed. 3 tabs.

12312 (DOE/PC/90005–T33) **Liquid phase methanol LaPorte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 12, 1**

April–30 June 1990. Air Products and Chemicals, Inc., Allentown, PA (USA). Chem Systems, Inc., Tarrytown, NY (USA). 23 Oct 1990. 41p. Sponsored by USDOE., DOE Contract AC22-87PC90005. (DOE/PC/89865–T1). Order Number DE91007397. Source: OSTI; NTIS; GPO Dep.

The objectives of this program are to implement and test the process improvements identified through the engineering studies of the current program to demonstrate the capability of long-term catalyst activity maintenance, and to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH) facility. An optional series of PDU runs is offered to extend the testing of the process improvements. A parallel research program will be performed to enhance the LPMEOH technical data base to improve the likelihood of commercialization of the LPMEOH process. Activities this quarter include: Flow sheet development for La Porte PDU modifications continues. A preliminary P&ID review was completed and flow sheet modifications were identified and are being incorporated. A preliminary hazards review was completed on 22 May. Some minor flow sheet modifications resulted and a number of action items were identified. The most significant action item is to develop a materials reactivity and compatibility grid for the different alcohols, ethers, and esters which will be produced at the PDU. Heat and material balances were completed for the maximum production case of the mixed DME/MEOH synthesis campaign. An improved rate expression was developed. 1 fig.

12313 (DOE/PC/90005–T35) **Liquid phase methanol La-Porte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 13, July 1–September 30, 1990.** Brown, D.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)); Frank, M.E. Air Products and Chemicals, Inc., Allentown, PA (USA); Chem Systems, Inc., Tarrytown, NY (USA). 26 Feb 1991. 29p. Sponsored by USDOE., DOE Contract AC22-87PC90005. Order Number DE91008149. Source: OSTI; NTIS; GPO Dep.

The objectives of this program are to implement and test the process improvements identified through the engineering studies of the current program, to demonstrate the capability of long-term catalyst activity maintenance, and to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH) facility. An optional series of PDU runs is offered to extend the testing of the process improvements. A parallel research program will be performed to enhance the LPMEOH technical data base to improve the likelihood of commercialization of the LPMEOH process. Current progress includes: (1) a change in the scope of work for the proposed DOE contract "Development of Alternative Fuels from Coal-Derived Syngas" (Alt Fuels I) was agreed upon by DOE and Air Products. This change requires that an operational run be made at the LaPorte AFDU in the March–April 1991 time frame. The run will demonstrate "Enhanced Syngas Conversion" by coproducing dimethylether/methanol (DME/MeOH) mixtures. Due to this change in scope, the engineering efforts directed toward the future plant modifications (now scheduled for the summer of 1992) were temporarily suspended. Engineering efforts were directed toward plant modifications which would be required to carry-out the Spring 1991 run; (2) in support of Process efforts, MIS-RES has added new thermodynamic correlations for carbon dioxide and selected alcohols and ethers. These correlations enable the liquid-liquid-vapor equilibrium for mixtures such as dimethyl ether and water, to be more accurately determined; and (3) a patent entitled "IGCC Process with Combined Methanol Synthesis/Water Gas Shift for Methanol and Electric Power Production" was granted to Air Products.

12314 (DOE/PC/90044–1) **High octane ethers from synthesis gas-derived alcohol: Technical progress report, September 25, 1990–December 24, 1990.** Klier, K. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry); Herman, R.G.; Bastian, R.D.; DeTavernier, S. Lehigh Univ., Bethlehem, PA (USA). Jan 1991. 44p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-90PC90044. Order Number DE91008367. Source: OSTI; NTIS; GPO Dep.

The objective of the proposed research is to synthesize high octane ethers directly from coal-derived synthesis gas via alcohol mixtures that are rich in methanol and isobutanol. The overall scheme involves gasification of coal, purification and shifting of the synthesis gas, higher alcohol synthesis, and direct synthesis of ethers. Commercial acid and superacid resin catalysts were obtained and tested under one set of conditions to compare the activities and selectivities for forming the unsymmetric methylisobutylether (MIBE) by coupling methanol with isobutanol. It was found that both Nafion-H microsaddles and Amberlyst-15 resins are active for this synthesis reaction. While and the Nafion-H catalyst does form the MIBE product fairly selectively under the reaction conditions utilized, the Amberlyst-15 catalyst formed dimethylether (DME) as the major product. In addition, significantly larger quantities of the C_4 hydrocarbon products were observed over the Amberlyst-15 catalyst at 123°C and 13.6 atm. It has been demonstrated that methyltertiarybutylether (MTBE) MIBE, DME and diisobutylether (DIBE) are separated and quantitatively determined by using the proper analytical conditions. In order to gain insight into the role of superacidity in promoting the selective coupling of the alcohols to form the unsymmetric ether, the strengths of the acid sites on the catalysts are being probed by thermometric titrations in non-aqueous solutions. 18 refs., 20 figs., 4 tabs.

12315 (DOE/PC/90289–T1) **Mild coal pretreatment to improve liquefaction reactivity: Quarterly technical progress report, September–November 1990.** Miller, R.L. Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining. [1990]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90289. Order Number DE91008485. Source: OSTI; NTIS; GPO Dep.

This report describes work completed during the first quarter of a three year project to study the effect of mild chemical pretreatment on coal dissolution reactivity during low severity liquefaction or coal/oil co-processing. The overall objective of this research is to elucidate changes in the chemical and physical structure of coal by pretreating with methanol or other simple organic solvent and a trace amount of hydrochloric acid and measure the effect of these changes on coal dissolution reactivity. Research during the last quarter focused on obtaining "baseline" reactivity data for four Argonne Premium coals (Wyodak, Illinois #6, Pittsburgh #8, and North Dakota lignite) at a representative set of low severity reactivity conditions. Dried, untreated coal samples and coal samples treated with methanol/HCl and hexane/HCl for three hours were liquefied at 350°C reaction temperature and 1000 psig H_2 initial pressure for 30 minutes. Initial results showed that the reactivity of each coal was enhanced by each pretreatment method. While preliminary, these data suggest that, in addition to alkylation of the coal's organic phase, other chemical and perhaps physical effects occur during pretreatment which affect dissolution of the coal. Work during the next quarter will begin to quantify the importance of these effects. 44 refs., 1 fig.

12316 (DOE/PC/90512–2942) **Combustion front propagation in underground coal gasification: Final report.** Dobbs, R.L. II; Krantz, W.B. Colorado Univ., Boulder, CO (USA). Dept. of Chemical Engineering. Oct 1990. 403p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-86PC90512. Order Number DE91002041. Source: OSTI; NTIS; GPO Dep.

Reverse Combustion (RC) enhances coal seam permeability prior to Underground Coal Gasification. Understanding RC is necessary to improve its reliability and economics. A curved RC front propagation model is developed, then solved by high activation energy asymptotics. It explicitly incorporates extinction (stoichiometric and thermal) and tangential heat transport (THT) (convection and conduction). THT arises from variation in combustion front temperature caused by tangential variation in the oxidant gas flux to the channel surface. Front temperature depends only weakly on THT; front velocity is strongly affected, with heat loss slowing propagation. The front propagation speed displays a maximum with respect to gas flux. Combustion promoters speed front propagation; inhibitors slow front propagation. The propagation model is incorporated into 2-D simulations of RC channel evolution utilizing the boundary element method with cubic hermetian elements to solve the flow from gas injection wells through the coal to the convoluted, temporally evolving, channel surface, and through the channel to a gas production well. RC channel propagation is studied using 17 cm diameter subbituminous horizontally drilled coal

cores. Sixteen experiments at pressures between 2000 and 3600 kPa, injected gas oxygen contents between 21% and 75%, and flows between 1 and 4 standard liters per minute are described. Similarity analysis led to scaling-down of large RC (≈1 m) to laboratory scale (≈5 cm). Propagation velocity shows a strong synergistic increase at high levels of oxygen, pressure, and gas flow. Char combustion is observed, leaving ash-filled, irregularly shaped channels. Cracks are observed to penetrate the char zone surrounding the channel cores. 69 refs., 54 figs., 4 tabs.

12317 (ETY–26/1990) **Reservations for coal gasification in conventional natural gas fired combined cycle and coal fired power plants.** Lassila, I.; Lehdonvirta, H. Finnish Energy Economy Association, Helsinki (Finland). 1990. 134p. (In Finnish). Project KTM-181/881/88. Order Number DE91753000. Source: OSTI; NTIS (US Sales Only).

JALO Research Programme.

In this project the status of coal gasification was studied. The main objective was to investigate which kind of reservations are needed in designing and constructing of conventional natural gas fired combined cycle and coal fired power plants if for any reasons their modification to coal gasification becomes reality. The coal gasification technology seems to be already on a commercial level. Several plants based on oxygen gasification/cold gas purification are under design and construction. The hot gas clean up systems are under development stage. In future, the concept based on air gasification/hot gas clean up will be better than the concept based on oxygen gasification/gold gas purification in terms of investment costs and efficiency. The reservations needed for coal gasification were investigated in two poweer plants. The first one was a natural gas fired combined cycle and the other one a conventional coal fired power plant. The reservations needed in a combined cycle power plant are area and space reservations as well as some reservations to power plant equipment eg. regarding the gas turbine. The modification of a conventional coal fired power plant to coal gasification has a different objective than the modification of natural gas combi plant. By adding a gas turbine and coal gasification to the existing process, the increase of power capacity and efficiency is achieved. The reservations needed are mainly area and space reservations. In the study, also the premises of a centralized coal gasification plant (plant producing synthetic natural gas) was investigated. The centralized coal gasification concept is technicly ready but economically unprofitable, with the present fuel prices.

12318 (ORNL/M–1165) **Conference on fossil energy materials: Abstracts.** Miller, P. (ed.). Oak Ridge National Lab., TN (USA). [1990]. 61p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (CONF-900546–Absts.: 4. conference on fossil energy materials, Oak Ridge, TN (USA), 15-17 May 1990). Order Number DE91008914. Source: OSTI; NTIS; GPO Dep.

Abstracts from the fourth annual conference on Fossil Energy Advanced Research and Technology Development (ARTD) Materials are presented. The objective of the Fossil Energy (AR&TD) Development Materials Program is to conduct research and development on materials for fossil energy applications, focusing on the longer-term needs for materials with general applicability to the various fossil fuel technologies. Research is aimed at a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial improvement in plant operations and reliability. The scope of the AR&TD Program addresses materials requirements for all fossil energy systems, including materials for coal processing, coal liquefaction, coal gasification, heat engines and heat recovery, combustion systems, and fuel cells. Work is in progress at national and government laboratories, universities, and industrial research facilities in the areas of ceramics, corrosion and erosion research, new alloys, and technology development and transfer.

12319 (STU–85-3348) **Gasification of pulverized coal in a cyclone combustor.** Zetterlund, B. (Royal Inst. of Tech., Stockholm (SE). Dept. of Production Technology, Mining and Steel Industry); Linder, P. Swedish National Board for Technical Development, Stockholm (Sweden). 16 Mar 1990. 131p. (In Swedish). Order Number DE91753023. Source: OSTI; NTIS (US Sales Only).

The possibility to increase the amount of pulverized coal that can be injected into a blast furnace by using a cyclone combustor have been studied. Through combustion of the coal in a cyclone, a better mixing of pulverized coal and air blast is achieved, which gives a prolonged reaction time. The experiments showed that it is possible to burn pulverized coal to a varying CO/CO_2-ratio in the exhaust gases from the cyclone. Calculations indicate that injection of pulverized coal can be increased by means of cyclone technique, which would lead to a pronounced reduction of coke consumption together with a slight reduction of total fuel consumption. (U.W.).

0105 Products and By-Products

Refer also to citation(s) 12302

12320 (ETDE/JP-mf–1749766, pp. 6-9) **Production of MgO composite using mesophase-pitch as binder.** Mochida, I. (Kyushu University, Fukuoka (Japan). Institute of Advanced Material Study); Korai, Y.; Akashi, N.; Fujiura, R.; Ito, K. Fuel Society of Japan, Tokyo (Japan). 12 Apr 1990. 62p. (In Japanese). In *Summaries of the studies published in No.88 Cokes Special Meeting held in April 1990 by Coke Department of The Fuel Society of Japan.* Order Number DE91749766. Source: OSTI; NTIS (US Sales Only).

This paper studied the production of refractory containing high strength carbon of low temperature baking as the aggregate of MgO by using mesophase-pitch of low softening point as binder which exhibits strength through high temperature sintering of higher carburizing yield. When MgO is formed at room temperature by using 5-6% mesophase-pitch as the binder and then baked, the strength arrived to 100kgf/cm ^{2} at 600 centigrade. When this is sintered at higher temperature up to 1300 centigrade, cleavage strength of about 70kgf/cm $_2$ can be expected. The relationship between softening point of mesophase-pitch and cleavage strength of sintered body was determined and the maximum strength was obtained by the pitch having softening point at about 270 centigrade. This suggests that the carburizing yield of pitch and softening dispersion are the important factors for the cleavage strength. On the other hand, the mixing method of MgO and pitch is estimated to have large influence to disperse the pitch. If pitch can disperse on MgO particles when pitch melts, the increase of adhesion can be expected. 2 refs., 5 figs., 1 tab.

0106 Properties and Composition

Refer also to citation(s) 12286, 12288, 12303, 12311, 12315, 12393, 12394

12321 (CONF-900858–, pp. 234-240) **Studies of the energetics of C-S bond-breaking reactions in radical ions derived from coal model compounds.** Bausch, M.J. (Southern Illinois Univ., Carbondale (USA)); Gostowski, R.; Guadalupe, C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA): 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

This article contains details of the investigations of C-S bond strengths in radical anions derived from coal model compounds. During the course of this project, the have examined the strengths of C-S bonds contained in radical anions derived from the isomeric species 9-phenylthiomethylanthracene (1) and 10-phenylthio-9-methylanthracene (2). BDEs [band dissociation energies] for the weakest C-S bonds in the radical anions derived from 1 and 2 are 10 and 38 kcal/mol, respectively. These data suggest that reductive chemistries carried out on sulfur-containing coal model compounds result in the weakening of the C-S bonds present in these species.

12322 (DOE/PC/88922–10) **Supercritical fluid thermodynamics for coal processing: Quarterly progress report, October 1, 1990–December 31, 1990.** van Swol, F. (Illinois Univ., Urbana, IL (USA). Dept. of Chemical Engineering); Eckert, C.A. Illinois Univ., Urbana, IL (USA). Dept. of Chemical Engineering. [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE

Contract FG22-88PC88922. Order Number DE91008354. Source: OSTI; NTIS; GPO Dep.

Because of their unusual solvating and mass transfer properties, supercritical fluids show potential for a variety of coal processing applications. We have established a database of coal model compound equilibria; to add to this database, we have developed and are testing techniques of measuring entrainer effects on solubility rapidly. In addition, we have used fluorescence spectroscopy to study the nature of entrainer effects on a molecular level. The solubility and spectroscopic measurements are being used in the development of an equation of state that includes both physical and chemical interactions; we are currently testing the equation. The equation of state will be used to predict solubility behavior so systems can be designed for the processing of coal with supercritical fluids. 2 figs.

12323 (DOE/PC/88939–12) **Methane formation and retention in coal: Quarterly technical progress report, October 1, 1990–December 31, 1990.** Hucka, V.J. Utah Univ., Salt Lake City, UT (USA). Dept. of Mining Engineering. [1990]. 12p. Sponsored by USDOE,. DOE Contract FG22-88PC88939. Order Number DE91008353. Source: OSTI; NTIS; GPO Dep.

The methane content of coal seams in Utah and Colorado will be measured in situ as well as in the laboratory and correlated with the geological and geochemical history of the seams and surrounding strata. Chemical and physical properties will be measured in the laboratory for coals that contain methane and coals of similar rank which do not contain methane. Methane yields on pyrolysis will be used to measure the propensity of coals on similar rank which do not contain methane. Methane yields on pyrolysis will be used to measure the propensity of coals to form additional methane. Methane formation and retention will be interpreted in terms of the physical and chemical properties of the coal and the chemical and geological history of the coal seam. 1 ref., 4 figs., 4 tabs.

12324 (OY/PSTL-RR–102, pp. 37-40) **The Vaala peat project.** Kaleva, P. (Commune of Vaala, Vaala (Finland)). Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

The first phase comprised a chemical mapping of the peatlands in the area. Three mires in the commune of Vaala, Tuulensuo, Matorimpi and Kaerjenrimpi, with a total area of approximately 500 hectares were selected for research purposes. These represent typical peatlands of this area with a Carex peat type (C and SC peat). The preliminary mapping and sampling of the peatland was carried out in summer 1988. Approximately 1 research point per 20 hectares was selected for chemical analyses and samples were taken from the surface to the botton of the peat deposit at each point. Peat type and degree of decomposition were determined in the field. A total of 175 samples were taken at 26 such points. Analyses of pH, water and ash content and chemical components extracted by organic solvents or dilute alkaline solutions were carried out in a peat laboratory set up in Vaala in autumn 1988, employing peat samples fractionated by the methods used at the Institute of Chemistry, University of Joensuu. The peat was divided into four fractions by this means: bitumen, fulvic acids, humic acids and humine. The pH of the samples varied from 3.7 to 5.8 and the ash content from 1.5% to 7%. The bitumen content of chemical extracts was usually highest (7-12%) in the mid-part of the peat profile, at a depth of approx. 50-130 cm. The proportion of fulvic acid was over 5% in the almost unhumified or poorly humified surface peat and decreased to 1-2% in the lower layers. The proportions of humic acid were low in the surface layers (8-29.7%) and increased to more than 40% at the bottom of the deposit. The humine fraction behaved in the opposite manner to the humic acid fraction.

0108 Waste Management

Refer also to citation(s) 12311, 12375, 12389, 12392, 12411, 12642, 12643, 12644, 12645, 12646, 12647, 12902, 12903, 12947, 13163, 13445, 13494

12325 (CONF-900858–, pp. 48-80) **Reburn technology for boiler NO_x control.** Borio, R.W. (Combustion Engineering, Inc., Windsor, CT (USA)); LaFlesh, R.C.; Lewis, R.D.; Hall, R.E.; Lott, R.A.; Kokkinos, A.; Durrani, S. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Cyclone fired units typically produce the highest nitrogen oxide (NO_x) emissions of the commonly employed boiler designs. Although cyclone-units represent about 14% of the pre-new source performance standards (NSPS) coal fired generating capacity, they contribute about 21% of the NO_x emitted by pre-NSPS units. Reburning is currently viewed as the most promising in-furnace NO reduction technology for cyclone fired boilers. Based on the above the U.S EPA, Electric Power Research Institute, Gas Research Institute, and Ohio Coal Development Office have cosponsored Combustion Engineering's demonstration of reburning on a large cyclone fired boiler. Key elements of the program include reburn system design and retrofit, followed by short and long term test segments, and an overall economic evaluation of reburning applicability. Coal is the primary boiler fuel and natural gas will be used as the reburn fuel. The paper reports the progress principally of the design related phases of the, program. Reburn system design criteria are presented as well as the methodology and results of the cold-flow modeling evaluation which was used to identify existing boiler aerodynamics and help to determine the optimum configuration for reburn fuel and additional air injectors. Mathematical modeling was conducted to determine potential effects of a reburn system on boiler thermal performance. Experience has been cited regarding effects of low air/fuel stoichiometric conditions on boiler tube wastage. Finally, a current day economic analysis is presented which is specific to the demonstration described herein.

12326 (CONF-900858–, pp. 174-175) **Coal desulfurization in a rotary kiln combustor.** Cobb, J.T. Jr. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

BCR National Laboratory (BCRNL) will spearhead a project aimed at evaluating the technical and economic feasibility of using a rotary kiln, suitably modified to burn Pennsylvania high-sulfur bituminous coal as well as anthracite wastes. Limestone will be injected into the kiln for sulfur control, to determine whether high sulfur capture levels can be achieved with high sorbent utilization. The objectives of the project are: to investigate the feasibility of burning high-sulfur bituminous coal and anthracite refuse, with limestone injection for sulfur emissions control, in a rotary kiln fitted with a Universal Energy International air distributor; to determine the operating conditions and the Ca/S ratios that are required to meet New Source Performance Standards; to evaluate the technical and economic merits of a commercial rotary kiln combustor in comparison with a fluidized-bed combustor; and to ascertain the need for further work, including additional combustion tests, prior to commercial application.

12327 (CONF-900858–, pp. 336-343) **Fundamental investigation of duct injection/ESP phenomena: 1.7 MW pilot plant results.** Brown, C.A.; McGuire, L.M. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

One major effort under DOE-PETC's Flue Gas Cleanup program is focused on developing duct injection of calcium-based reagent into the flue gas between the air heater and an existing electrostatic precipitator (ESP). The goal for this technology is to be suitable for retrofit to existing boilers firing medium- to high-sulfur coal and be capable of a minimum of 50% SO_2 removal at a cost of less than $500/ton of SO_2 removed. Even though the duct

injection process is an outwardly simple process, several key phenomena are not well understood. Radian Corporation has been contracted by DOE-PETC to investigate the fundamentals of these phenomena in a 1.7 MW pilot plant. The purpose of this study is to obtain a better understanding of the basic physical and chemical phenomena that control: (1) the desulfurization of flue gas by calcium-based reagent, and (2) the coupling of an existing ESP particulate collection device to a duct injection process. Results to date are discussed.

12328 (CONF-900858–, pp. 344-351) **Scaleup tests and supporting research for the development of duct injection technology.** Hunt, J.E. (Gilbert/Commonwealth, Inc., Reading, PA (USA)); Gooch, J.P. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The Department of Energy's (DOE) Duct Injection Test Facility, located in Beverly, Ohio at the Muskingum River power plant of Ohio Power Company has been converted to test alternative duct injection technologies. Gilbert/Commonwealth, Inc. and Southern Research Institute are working on the project. The technologies to be tested include slurry sorbent injection of hydrated lime using dual fluid nozzles and pneumatic injection of dry hydrated lime with flue gas humidification before or after sorbent injection. The test facility was modified to test a range of flue gas SO_2 concentrations and a range of flue gas temperatures in vertical and horizontal duct test sections. This test program is part of a larger DOE program to fully characterize low cost, retrofittable dry SO_2 removal technologies for application to existing power plants.

12329 (CONF-900858–, pp. 352-358) **Duct injection technology engineering design and scale-up criteria.** Ireland, P.A.; Martin, C.E. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

One of this nation's priority energy goals is improving the environmental acceptability of coal, through the reduction of its acid rain potential. The objectives of the Department of Energy's Duct Injection Technology Prototype Development project are to develop and verify the necessary engineering design and scale-up criteria for the commercialization of duct injection technology for the removal of SO_2 in the utility industry. Duct injection involves the introduction of lime, either dry or slurried, into the flue gas ductwork downstream of the air heater in a coal-fired utility boiler. United Engineers & Constructors is responsible for developing these design guidelines for retrofit to existing utility power plants. A duct injection Design Handbook and a three-dimensional predictive mathematical model of the process will constitute the two primary work products of this project. Babcock & Wilcox's Research Division has been subcontracted to provide expertise in the following areas: (1) Completion of the predictive mathematical duct injection model, (2) Development of advanced slurry and water spray nozzle criteria for nozzle retrofit into the existing ductwork, (3) Supporting experimental studies (including nozzle array testing, corrosion testing and gas flow modeling), and (4) Associated input to the Design Handbook. The University of North Dakota's Energy & Environmental Research Center (EERC) has been subcontracted to provide a characterization of the wastes produced from these processes and to develop a waste disposal by-product utilization strategy. The status of all these projects is described.

12330 (CONF-900858–, pp. 359-366) **Reactivity of $Ca(OH)_2$ with SO_2 under duct injection conditions.** Jozewicz, W. (Acurex Corp., Research Triangle Park, NC (USA)); Chang, J.C.S.; Rochelle, G.T. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The results of experimental work testing mass transfer variables and examining various techniques that could enable high sorbent utilization during duct flue gas desulfurization processes are presented. The conversion of Mississippi hydrated lime increased with increasing relative humidity (RH). The calcium silicate sorbent was uniformly better than Mississippi hydrated lime, giving the same conversion in 3-5 times less reaction time. There was little effect of SO_2 concentration (500-3,000 ppm range) on the measured conversion of reagent. The effect of 10-40 percent C_2 on the conversion of Mississippi hydrated lime with SO_2 was not significant. Conversion of $Ca(OH)_2$ was significantly enhanced by the presence of non-equilibrium moisture.Pilot scale injection of $MgSO4{\cdot}7H_2O$ into the duct did not achieve significant temperature drop as a result of evaporation of water. Notable enhancement of SO_2 removal took place as a result of a recycle upstream of the humidifier. The scope of planned future work for the area of dry- and slurry-injection into the duct is also discussed.

12331 (CONF-900858–, pp. 367-374) **Global studies of enhanced mass transfer applied to in-duct flue gas desulfurization.** Cole, J.A. (Energy and Environmental Research Corp., Irvine, CA (USA)); Newton, G.H.; Kramlich, J.C.; Payne, R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Duct injection is one of a number of technologies which seeks moderate to high levels of SO_2 control through the use of inexpensive calcium-based sorbents. Duct injection is defined as the injection of calcium hydroxide, in either dry or slurry form, after the air heater. It operates through the formation of a $CaSO_3$ solid which is collected by the particulate control device. Two major challenges face the implementation of the duct injection process. First, these close approaches to adiabatic saturation can lead to operability problems. Second, even at high humidities, the sorbent utilization is not as high as would be desired. Increased sorbent reactivity would reduce the need for close approaches to the saturation point. It could also lower process costs by reducing the amount of sorbent needed for a given SO_2 capture. The objectives of this project are to identify the factors that govern the rate of sulfur capture by slurry droplets. When identified, these rates are to be used to select and test enhancement strategies. A fundamental experiment that investigated the reaction of individual slurry droplets is the heart of the study. A model was concurrently developed to (1) interpret the data from the fundamental experiment, and (2) provide a tool for extrapolating the findings to practical scale. Results to date are discussed and preliminary conclusions are given.

12332 (CONF-900858–, pp. 383-390) **Pilot-scale evaluation of the HYPAS SO_2 and particulate matter removal process.** Rhudy, R.G.; Carr, R.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Evaluation of the HYPAS process at 4 MWe scale was conducted at EPRI's High Sulfur Test Center using hydrated lime. Once-through tests showed that at an approach-to-saturation temperature (ΔTapp) of 20°F and calcium-to-sulfur ratio (Ca/S) of 2, SO_2 removal increased from approximately 40 percent at an inlet SO_2 concentration of 2500 ppm, to 51 percent at an inlet SO_2 concentration of 1000 ppm. Further, at a ΔTapp of 10°F, SO_2 removal increased from approximately 47 percent at an inlet SO_2 concentration of 2500 ppm, to 75 percent at an inlet SO_2 concentration of 680 ppm. Other results showed that at a ΔTapp of 20°F, Ca/S of 2, and inlet SO_2 concentration of 1500 ppm, injection of ground recycle increased SO_2 removal from 44 percent (once-through operation) to 69 percent (recycle ratio of 5). Particulate matter collection efficiency averaged 99.9+ percent, with outlet emissions less than 0.002 lb/MBtu, and outlet opacity less than 1 percent. The HYPAS process is comprised of four basic steps which occur sequentially in the flue gas flow stream: (1) fly ash removal by an

existing electrostatic precipitator; (2) evaporative cooling by water injection to within 10 F - 20 F above the flue gas adiabatic saturation temperature; (3) dry alkali injection for reaction with SO_2 in the flue gas; and (4) collection of the desulfurization by-products in a rotrofitted pulse-jet fabric filter (baghouse).

12333 (CONF-900858–, pp. 391-398) **Wet FGD chemistry research at EPRI's high sulfur test center.** Moser, R.E. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

This paper summarizes some of the results from the wet FGD system tests completed during the first two years of operation. There are three wet FGD test units currently operating at the HSTC including: A 4.0 MWe pilot system which treats 12,000 acfm of flue gas; A 0.4 MWe mini-pilot system which treats 1,200 acfm of flue gas; and A bench-scale system which treats 5 acfm of flue gas. Brief descriptions are given of five studies which have been under taken so far and of four studies planned for the future. Results are described from a baseline limestone study and a study of thiosulfate additive chemistry.

12334 (CONF-900858–, pp. 399-406) **An evaluation of a pre-charging pulse jet filter for small combustor particulate control.** Quimby, J.M.; Helfritch, D.J. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective of this test program is the performance and economic evaluation of a precharged pulse jet filter (PCPJF) as the principal particulate control device for a commercial or industrial scale coal fired combustor. Performance factors that will be considered are the effects of particle charge, air cloth ratio, percent humidity and inlet particulate loading on fine particle collection efficiency, and pressure drop. Economic factors that will be considered are capital costs, energy and other operating costs, and maintenance costs. This research project is divided into six distinct functional categories, or tasks, which will be completed in sequence. These tasks are categorized as follows: work plan; design, procurement, and installation; shakedown; test program; analysis and economic evaluation; and reporting. At present the work schedule is in the shakedown period. An illustration of the test system apparatus is provided. The negative corona pre-charger is located at the top of the hopper section of the baghouse. Ceramic cylinders are used to separate the ground plate from the discharge needles at a distance of 1 inch. Results to date are described.

12335 (CONF-900858–, pp. 407-414) **Electrostatic precipitation of condensed acid mist.** Dahlin, R.S. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Southern Research Institute is developing a compact, wet electrostatic precipitator (WESP) to control acid mist emissions from high-sulfur coal combustion. Phase I involved initial testing of the WESP concept in the laboratory and in a pilot-scale coal combustion facility, along with the development of a WESP computer model. Phase II involves field measurements of the acid mist loading and size distribution, more refined projections of WESP performance and size requirements, and solicitation of utility participation in a follow-on demonstration of the WESP technology. The primary objectives of the Phase I effort were to: (1) determine the ability of a compact WESP to collect the fine acid mist, (2) determine the effect of fly ash loading on mist collection efficiency, and (3) develop and validate a computer model of the WESP to help interpret test results and extrapolate results to full-scale applications. The second objective was included because a very high loading of submicron fly ash could adversely affect WESP performance by space charge suppression of the corona current. The primary objectives of Phase II are to: (1) obtain data on the mass loading and size distribution of the acid mist, fly ash, and scrubber carryover present in flue gas from wet FGD systems at two utility sites, (2) use the mass loading and sizing data to make more refined projections of WESP performance and size requirements, and (3) solicit utility participation in a follow-on demonstration of a prototype WESP. The computer projections, based on the validated WESP computer model developed under Phase I, will serve as the basis for the design of the prototype WESP. Since work has just begun on Phase II, this paper concentrates on the results of the Phase I work.

12336 (CONF-900858–, pp. 415-422) **A confined vortex scrubber for flue gas cleaning.** Loftus, P.J. (Avco Research Lab., Everett, MA (USA)); Stickler, D.B.; Diehl, R.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

A flue gas cleanup device suitable for advanced small scale coal combustors is being developed. A program of two-phase vortex experiments has led to the development of a CVS which produces high radial accelerations, good liquid containment and an extremely vigorous air/liquid interaction at an acceptable pressure drop. The CVS design retains the mechanical simplicity of conventional reverse flow cyclone separators, but has superior collection performance for fine particulates. Preliminary cleanup experiments indicate collection efficiencies in excess of 99 percent for fine fly ash at low liquid flow rates. The collection efficiency is not a strong function of air mass flow rate, dust loading or liquid flow rate. The device also has the potential for controlling SO_x and/or NO_x emissions by suitable choice of a liquid scrubbing medium.

12337 (CONF-900858–, pp. 423-429) **Cross-flow filter-sorbent-catalyst for particulate, SO_2 and NO_x control.** Benedek, K.R. (Arthur D. Little, Inc. (USA)); Flytzani-Stephanopoulos, M.; Hu, Zhicheng; Sarofim, A.F. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective of this program is to successfully carry out the experimental and design tasks that will lead to the development of a single-unit, cross flow filter-sorbent-catalyst. The authors plan to carryout the research and design work in two stages. The first stage of the work (Phase I) will be fundamental in nature: they will investigate the SO_2 removal and NO_x reduction characteristics of different sorbent-catalyst compositions (in bulk, granular form) and will conduct exploratory tests of cross-flow filters under conditions similar to those found in the combustion gases of small-scale combustors. After a year of these fundamental studies, the authors will conduct a preliminary evaluation of the component performance and will design two or three prototype configurations. In the subsequent stage of the program (Phase II), they will investigate the pollutant control characteristics of prototype filter-sorbent-catalyst devices. The SO_2 removal and NO_x reduction efficiency of a unit-element prototype will be investigated. This unit element will be a slot reactor comprised of two flat porous walls, or slabs of filter-sorbent-catalyst material separated by a 0.5 centimeter gap. The particulate collection efficiency and back-flushing requirements of a multi-element version of this device will be tested. Concurrent with these efforts will be the investigation of a sorbent regeneration scheme that has the potential to produce elemental sulfur in a one step process. Final evaluation of component performance and the design of these emissions control devices for residential, commercial, and small industrial applications will be conducted at the conclusion of the project. Results to date are given.

12338 (CONF-900858–, pp. 430-437) **Development of an integrated emissions control system for residential CWS [coal water slurry] furnaces.** Balsavich, J.C. Jr.; Breault, R.W. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal*

preparation, utilization, and environmental control contractors conference. Proceedings. 604p. Order Number DE91004208. Source: OSTI; NTIS.

The goal of this program is to develop an emissions control system that can be easily integrated into a CWS-furnace system and is capable of meeting the emissions levels of 0.2 lbm of NO, per million Btu fired, 0.4 lbm of SO_2 per million Btu fired, and 0.02 lbm of particulates per million Btu fired. The principal components that are being developed as part of the integrated emissions control system include the combustor, the emissions control reactor, and the fine particulate control chamber. The emissions control reactor is primarily concerned with the post-combustion reduction of SO_2 emissions. The reactor design makes use of the natural pressure distribution that exists in the imposed vortical flow field to provide for particle recirculation without the need for external devices. By allowing the sorbent particles to recirculate within the reactor, for any particular sorbent-to-sulfur ratio, the available surface area within the reactor can be greatly increased. Due its principle of operation, the emissions control reactor has the ability to separate and collect relatively coarse particulates. In order to collect the fine particles that are a key concern of this program, a separate, fine particle control chamber will be used. This chamber will use high-efficiency bag filters to collect the 0.5 to 10 μm particles to the required 99.9-percent collection efficiency. This paper describes the significant features of Tecogen's residential-scale, integrated emissions control system for CWS furnaces. Recent preliminary NO_x reduction data are also presented.

12339 (CONF-900858–, pp. 438-445) **Simplified wet scrubbing process for SO_2 and NO_x removal from flue gas.** Walker, R.J. (Pittsburgh Energy Technology Center, PA (USA)); Perry, M.B. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

A regenerable process for simultaneously removing SO_2 and NO_x from flue gas and producing gypsum is described. The process uses a scrubber with an aqueous absorbent to simultaneously remove SO_2 and NO_x. The aqueous absorbent contains a buffer to facilitate SO_2 removal, and iron EDTA for NO_x removal. Regeneration of the absorbent involves a reducing reactor and electrodialysis. The principal components of the process were successfully operated over ten cycles on a batch basis at laboratory scale using a bubble column and other equipment. Additional studies were carried out on a packed countercurrent column.

12340 (CONF-900858–, pp. 446-453) **A novel liquid membrane technique for removal of SO_2/NO_x from flue gas.** Majumdar, S. (Stevens Institute of Technology, Hoboken, NJ (USA)); Cha, J.S.; Papadopoulos, T.H.; Sirkar, K.K. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective of this project is to (i) measure the permeability coefficients of SO_2, CO_2, NO, O_2 and N_2 through a variety of immobilized liquid membranes (ILMs) using simulated flue gas mixtures, (ii) select the promising liquid membranes, (iii) study the extent of flue gas purification achieved in a novel microporous hollow-fiber-contained liquid membrane (HFCLM) permeator using selected membrane liquids, and (iv) determine the stability and reliability of this novel permeator for different operational modes. The ultimate goal of this work would be to have a hollow-fiber-contained liquid membrane (HFCLM) permeator purify flue gas containing SO_2/NO to the extent of about 90% using liquid membranes with a high selectivity of SO_2/NO over CO_2, N_2 and O_2 and having high flux levels for the preferentially permeating species. Results to date are described.

12341 (CONF-900858–, pp. 454-461) **Reactivity studies with novel ceria containing sorbents.** Hedges, S.W. (Pittsburgh Energy Technology Center, PA (USA)); Diffenbach, R.A. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The fluidized-bed copper oxide process is being developed for the simultaneous removal of 90% of both SO_2 and NO_x from the flue gas of coal-fired utility boilers. A process concept based on a CeO_2/Al_2O_3 sorbent is being studied as an alternative sorbent to copper oxide. CeO_2/Al_2O_3 sorbents have been prepared that have SO_2 reactivity comparable to or slightly higher than the CuO/Al_2O_3 sorbent, and can be regenerated in H_2 or CH_4 with essentially complete removal of sulfur. No loss of sorbent reactivity was observed for the CeO_2/Al_2O_3 sorbents upon multiple cycles of absorption and regeneration using either. However, the temperature of operation is higher for the CeO_2, 600°C compared to 400°C for CuO (CH_4 regeneration requires approximately 50°C higher temperature than absorption for either sorbent). $CeO_2/MnO_x/Al_2O_3$ and $CeO_2/CoO_x/Al_2O_3$ sorbents were also prepared and gave SO_2 reactivity quite comparable to the Ce-only sorbent. However, these composite oxide sorbents do not appear to offer an advantage to the Ce-only sorbent when H_2 is the reducing gas. Potassium-modified CeO_2/Al_2O_3 sorbents exhibited approximately 10-20% higher absorption capacity at comparable metal loadings than did the Ce-only sorbents, but the rate of SO_2 uptake was essentially the same.

12342 (CONF-900858–, pp. 462-469) **Integrated dry sorbent injection for coal-fired boiler SO_2 and NO_x control.** Helfritch, D.J. (Research-Cottrell Environmental Services and Technologies, Somerville, NJ (USA)); Bortz, S.J.; Beittel, R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The team of Research-Cottrell Environmental Services and Technologies and Riley Stoker are conducting a proof of concept demonstration of an Integrated Dry Injection process. The process consists of combustion modification using low NO_x, burners to reduce NO_x (i.e., NO + NO_2) emissions, dry injection of hydrated lime at economizer temperatures for primary capture of SO_2, dry injection of a commercial grade sodium bicarbonate at the air heater exit for additional SO_2 and NO_x, removal, and humidification for precipitator conditioning. The Integrated Dry Injection Process offers the potential for simultaneously achieving 90 +% SO_2 removal, and 75 +% NO_x removal from a high sulfur flue gas. The process is well suited for new or retrofit applications since it can be incorporated within existing economizer and downstream ductwork. In addition, capital costs are kept to a minimum since no large system components such as catalytic beds, spray dryers or scrubbers are required. Solvent evaluation results are given on calcium hydroxide and sodium bicarbonate sorbents.

12343 (CONF-900858–, pp. 470-477) **Catalytic fabric filtration for simultaneous NO_x and particulate control.** Weber, G.F. (Univ. of North Dakota (USA)); Laudal, D.L. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The focus of the Flue Gas Cleanup Program at the Energy and Environmental Research Center (EERC) is advanced NO_x and fine particulate control. The overall objective of the advanced NO_x project is to evaluate the potential of a catalytic fabric filter for simultaneous NO_x and particulate control. Specifications of the project are: 90% NO_x removal efficiency with <25 ppm ammonia slip; a particulate removal efficiency of >99.5%; a bag/catalyst life of >1 year; a 20% cost savings over conventional baghouse and SCR control technology; compatibility with SO_2 removal systems; and a nonhazardous waste material. Specific parametric and fabric screening tests using simulated flue gas were conducted in which the fabric wave, coating composition, and coating process were

adjusted to develop acceptable fabrics for further testing. Eight fabrics were selected. Results are discussed for the second task, namely, to further evalaute catalyst-coated fabric samples in the presence of flue gas generated during pulverized coal combustion. This was considered necessary to begin evaluating the potential effects of fly ash on catalytic performance: specifically, the effects of submicron particles, volatile species, and trace elements that could not be addressed using synthetic flue gas. Four coals were selected for testing, a medium sulfur washed Illinois No. 6 bituminous (the baseline coal), a high sulfur Pyro Kentucky bituminous, a Jacobs Ranch subbituminous, and a South Hallsville, Texas, lignite. Each of the eight fabrics were tested with the washed Illinois No. 6 bituminous coal. Based on the results of the eight fabric screening tests, two fabric samples were selected to be tested using the remaining three coals. The results of the fabric screening test using the eight fabric samples are presented in a table.

12344 (CONF-900858–, pp. 478-485) **Use of ferrous chelates for NO_x control in aqueous scrubbers.** Livengood, C.D. (Argonne National Lab., IL (USA)); Harkness, J.B.L.; Mendelsohn, M.H. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The research program has been focused on aqueous scrubber systems and has involved studies on NO_x, removal through chemical additives based on Argonne's patented ARGONOX additives. Tests have been conducted in laboratory-scale aqueous scrubbers of two types. The experimental conditions were selected to simulate scrubbing of high-sulfur coal effluent gases. Describes recently performed experiments with the primary additive ferrous. EDTA with an organic secondary additive and two parametric test series with the additives ferrous-EDTA (having an iron to EDTA ratio of 1:1.2) and ferrous-cysteine (having an iron to cysteine ratio of 1:6) in a sodium carbonate chemistry.

12345 (CONF-900858–, pp. 486-493) **LBL [Lawrence Berkeley Lab.] PHOSNOX process for combined removal of SO_2 and NO_x in wet limestone systems.** Chang, S.G. (Lawrence Berkeley Lab., CA (USA)); Littlejohn, D.; Liu, D. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Most of the NO_x in flue gas is NO (about 95%), which cannot be removed in a conventional wet limestone flue gas desulfurization (FGD) system because of its low solubility. One approach to avoid this problem is to oxidize NO to the more soluble NO_2. Several processes have been developed based on this approach by using oxidants such as O_3 or ClO_2. Despite high removal efficiency of both SO_2 and NO_x, these processes have not been demonstrated to be cost effective. The major reason is believed to be the high cost of these oxidants. The authors have recently discovered a new and cost-effective method for the generation Of O_3 in a wet limestone system. In previous O_3-based systems, O_3 was generated by a corona discharge which would consume about 7-9% of the energy produced from a power plant just to oxidize about 300-500 ppm NO in flue gas. This method uses the chemical reaction of yellow phosphorus (P4) with O_2 in flue gas to produce O_3 inside a scrubbing system. The major oxidation product of P4 is phosphoric acid, which is more valuable than P4 on a phosphorus weight basis. The objectives of this project during the past year were to construct a 20 acfm bench-scale wet scrubber system and to conduct proof of concept tests of P_4 additive with it. This paper addresses the test results. Also, a conceptual process flow diagram and a preliminary cost projection of a wet limestone system employing P4 additive for combined removal of SO_2 and NO_x are reported.

12346 (CONF-900858–, pp. 494-501) **Advanced non-catalytic post combustion NO_x control.** Chen, S.L. (Energy and Environmental Research Corp., Irvine, CA (USA)); Lyon, R.K.; Seeker, W.R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The effectiveness of combustion modifications, including staged combustion and reburning, for the control of nitrogen oxide emissions from coal or oil fired combustors is most often limited by problems due to carbon burnout or flame impingement. This paper presents new data on the use of selective reducing agents, such as ammonium sulfate, suggesting that a hybrid control scheme is possible which uses combustion modification to provide those conditions which optimize the selective reduction process. Very low emission levels appear possible that can presently only be achieved by catalytic reduction.

12347 (CONF-900858–, pp. 502-509) **NO_x destruction by distributed fuel addition.** Mereb, J.B. (Univ. of Arizona, Tucson (USA)); Wendt, J.O.L. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Mechanisms governing the inter-conversion and destruction of nitrogenous species in the fuel rich reburning zone of a laboratory coal combustor were explored. The objective was to extract models to be used in estimating reburning effectiveness in practical combustors. Reburning mechanisms occur in two regimes; one in which fast reactions between NO and hydrocarbons are usually limited by mixing; the other in which reactions have slowed and in which known gas phase chemistry controls. For the latter regime, a simplified model based on detailed gas phase chemical kinetic mechanisms and known rate coefficients was able to predict temporal profiles of NO, NH_3 and HCN. Reactions with hydrocarbons played important roles in both regimes and the Fenimore N_2 fixation reactions limited reburning effectiveness at low primary NO values.

12348 (CONF-900858–, pp. 510-517) **Flue gas humidification with the linear VGA [variable gas atomizing] nozzle.** Butz, J.R. (ADA Technologies, Inc., Englewood, CO (USA)); Armstrong, J.A.; Walsh, W.A. Jr. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Flue gas humidification between the air preheater and electrostatic is precipitator important in all of the calcium-based dry sorbent injection technologies now under development for SO_2 control in stationary sources. For in-duct processes, flue gas relative humidities of 50 to 70% are required to obtain the desired reaction rates between the sorbent particles and the flue gas SO_2. ADA Technologies, Inc. is to design, fabricate and test a linear variable gas atomizing (VGA) nozzle for use in flue gas humidification. The dual fluid VGA nozzle has a unique linear geometry that makes scaling the design to increase flowrate simply a matter of increasing the length of the nozzle. Another novel feature is that the thickness of the liquid sheet in the nozzle is controlled by the pressure differential between the water and air supplied to the nozzle. Phase I results are given. There are three major objectives for the Phase II development effort now under way: to optimize the performance of the proof-of-concept linear VGA nozzle via small changes in the design; to design and test a prototype (full scale) linear VGA nozzle; and to develop a commercial design for an in-duct humidification system that utilizes the performance features of the linear VGA nozzle. The final result of the Phase II project will be a commercial system design that is ready to move into industry for use in the humidification of flue gas in ducts. The specific studies under each of these 3 tasks are described.

12349 (CONF-900858–, pp. 518-525) **Development of a pulse combustor sorbent treatment and injection control technique.** Kelly, J.T. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug

1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Low cost, and retrofittable and effective SO_2 control techniques are needed for utility boilers. A potentially low-cost and retrofittable method of SO_2 control is the Direct Sorbent Injection (DSI) approach. However, direct sorbent injection has limited performance for inexpensive limestone sorbents (Ref. 2). This is primarily due to a lack of compatibility between optimal limestone calcination and sulfation conditions and typical furnace temperature histories. A Pulse Combustor Sorbent Treatment and Injection (PCSTI) concept has been identified which has the potential to overcome the limitations of DSI. This concept is retrofittable and utilizes inexpensive limestone sorbent. The main element of this concept is the valveless Pulse Combustor (PC). The PC operates without moving parts and, once started, an igniter is not required. The pulsations produced by the PC generate pressure waves which create oscillating velocity fields within and downstream of the PC exhaust which enhance gas/particle and gas/gas heat and mass transport through unsteady boundary layer processes. Also, the combustor eliminates the need for large power consuming fans for injection of the sorbent into the furnace. Work is proceeding to demonstrate the performance of the concept in a pilot-scale test facility that simulates the temperature and concentration histories of full-scale furnaces. Once the concept is proven in pilot-scale, work will be initiated to demonstrate the concept in a large-scale test facility. In addition, performance and economic analyses will be used to estimate the cost-per-ton of SO_2 removed for the PCSTI concept as applied to a fully-scale furnace. These results will be compared to DSI system results to determine the cost advantages of the PCSTI concept. Results to date are discussed.

12350 (CONF-900858–, pp. 530-541) **Plasma assisted NO_x reduction in existing coal combustors.** Yao, S.C. (Carnegie Mellon Univ., Pittsburgh, PA (USA)); Russell, T. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective is to explore the feasibility of using plasma produced chemical radicals to interact with the coal combustion processes to reduce NO_x emissions. Chemical kinetics of NH_3 and its radical derivatives (NH_2 and NH, in particular) has been studied. Both NH_2 and NH are very effective at reducing NO, though both have limited lifetimes. To increase lifetimes, and hence process effectiveness, two directions are planned for use. First, the addition of additional species can favorably modify the kinetics to increase radical lifetimes. Secondly, freezing the reactions by rapid expansion through a nozzle shows potential. Both avenues are being pursued further. The significance of the technical issues being addressed, the experimental and theoretical approaches being taken, and results to date are described.

12351 (CONF-900858–, pp. 542-549) **Reduction of NO_x and SO_2 emissions from coal burning pulse combustors.** Zinn, B.T. (Georgia Institute of Technology, Atlanta (USA)); Powell, E.A.; Chen, F.; Miller, N. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objectives of the current project are (1) to determine if the nitrogen oxides emissions from Rijke pulse combustors can be reduced by staging the combustion process and (2) to determine if the sulfur dioxide emissions from Fijke pulse combustors can be reduced by adding limestone or dolomite to the acoustically fluidized bed or to the flow of combustion gases above the bed. This research is directed at developing pulse combustion into a method of burning and unpulverized coal which can provide high combustion efficiency with low excess air and also meet the federal New Source Performance Standards for NO_x and SO_2 emissions from industrial boilers. The paper describes the experimental methods and apparatus and results. Comparison of the results of the pulsating and nonpulsating tests indicate that pulsations greatly increase the combustion efficiency for a given air/fuel ratio. Unfortunately pulsations also greatly increase the efficiency with which the fuel-bound nitrogen is converted into nitrogen oxides.

12352 (CONF-900858–, pp. 558-565) **Tung flue gas desulfurization.** Tung, S.E. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The Tung Flue Gas Desulfurization Process utilizes an innovative liquid/liquid extraction system to regenerate a sodium-based aqueous scrubbing liquor. Steam stripping of the solvent recovers SO_2 as a by-product, and requires only a fraction of the energy needed to steam strip SO_2 from the aqueous solution itself. Stone & Webster Engineering Corporation, Boston, MA, provided the Engineering support of the Phase I test program. During that phase, extraction and stripping unit operations were tested at bench-scale in order to demonstrate the operability of the system, and support selection of equipment for a demonstration plant test loop. A continuous extraction/stripping at bench-scale test rig was operated to demonstrate system performance and solvent stability. Some major test results will be presented in this paper. Phase II, scheduled to begin in mid-1990, will include design, installation and testing of a 3MW-scale flue gas slipstream test facility at Niagara Mohawk's Dunkirk Station. The purpose of this phase will be to demonstrate the performance and extended operation of the system on actual flue gas from a coal-fired power plant.

12353 (CONF-900858–, pp. 566-571) **The NOXSO POC pilot plant advanced flue gas clean-up technology.** Gilbert, R.L. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The MK-Ferguson Company is the engineering/construction member of a team that includes the NOXSO Corporation as the technology developer; W. R. Grace & Co-Conn as the sorbent supplier; and Ohio Edison as the owner of the host site. This team is working together to bring to commercial status the NOXSO simultaneous SO_2/NO_x Flue Gas Cleaning System. The objective of this project is to demonstrate the potential for application of the NOXSO Flue Gas Treatment (FGT) technology to coal-fired utility boilers in the 1990s. To accomplish this, the NOXSO team will design, construct, operate, and test a proof-of-concept (POC) scale NOXSO test facility at Ohio Edison's Toronto Station, a coal-fired power plant. The pilot plant will process a 12,000-SCFM slip stream of flue gas from the power plant. The goal of the POC test is to obtain the engineering data required to prepare a cost-effective design of a commercial- scale NOXSO process module at an acceptable level of technical risk. A secondary goal of the test program is to optimize process performance, i. e., achieve 90% removal of SO_2 and NO_x from the flue gas at the lowest possible cost, while maintaining the high level of system reliability required by the utilities market. The project is a scale-up of previous laboratory tests.

12354 (CONF-900858–, pp. 572-576) **Gas surface chemistry of flue gas sorbents.** Finseth, D. (Pittsburgh Energy Technology Center, PA (USA)); Hlivko, B.; Freeman, M. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The removal of the acidic components from the flue gas produced during coal combustion can be accomplished by a variety of techniques, including wet scrubbing, disposable dry sorbents, and regenerable sorbents. The chemistry occurring in dry processes, where solid sorbents are used to react with the acidic gas components, is often not well understood because of the difficulties of

studying the chemistry occurring between gaseous and solid reactants on a solid surface. The oxidation Of SO_2 to SO_4= by gaseous oxygen on the surface of a solid sorbent is the most important reaction in this study. We have a rather detailed understanding of the mechanism of similar reactions in homogeneous solution; however, both the rates and the mechanisms of reactions often change when the reagents are constrained to a surface. The goal of this work was to understand the nature of the chemistry occurring on the surface of regenerable sorbents by studying the reactions on the sorbent surface under realistic flue gas conditions. Infrared spectroscopy was chosen as the analytical technique because of its ability to observe most of the relevant species on the sorbent surface in the presence of flue gas at realistic flue gas temperatures.

12355 (DOE/MC/11076–2948) **Hoe Creek groundwater restoration, 1989.** Renk, R.R.; Crader, S.E.; Lindblom, S.R.; Covell, J.R. Western Research Inst., Laramie, WY (USA). Jan 1990. 210p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC21-86MC11076. Order Number DE91002026. Source: OSTI; NTIS; GPO Dep.

During the summer of 1989, approximately 6.5 million gallons of contaminated groundwater were pumped from 23 wells at the Hoe Creek underground coal gasification site, near Gillette, Wyoming. The organic contaminants were removed using activated carbon before the water was sprayed on 15.4 acres at the sites. Approximately 2647 g (5.8 lb) of phenols and 10,714 g (23.6 lb) of benzene were removed from the site aquifers. Phenols, benzene, toluene, ethylbenzene, and naphthalene concentrations were measured in 43 wells. Benzene is the only contaminant at the site exceeds the federal standard for drinking water (5 μg/L). Benzene leaches into the groundwater and is slow to biologically degrade; therefore, the benzene concentration has remained high in the groundwater at the site. The pumping operation affected groundwater elevations across the entire 80-acre site. The water levels rebounded quickly when the pumping operation was stopped on October 1, 1989. Removing contaminated groundwater by pumping is not an effective way to clean up the site because the continuous release of benzene from coal tars is slow. Benzene will continue to leach of the tars for a long time unless its source is removed or the leaching rate retarded through mitigation techniques. The application of the treated groundwater to the surface stimulated plant growth. No adverse effects were noted or recorded from some 60 soil samples taken from twenty locations in the spray field area. 20 refs., 52 figs., 8 tabs.

12356 (DOE/PC/79922–T6) **Cyclone performance and optimization: Thirteenth quarterly report.** Leith, D. North Carolina Univ., Chapel Hill, NC (USA). Dept. of Environmental Sciences and Engineering. 15 Dec 1990. 33p. Sponsored by USDOE,. DOE Contract FG22-87PC79922. Order Number DE91008440. Source: OSTI; NTIS; GPO Dep.

An empirical model for predicting pressure drop across a cyclone, developed by Dirgo (1988), is presented. The model was developed through a statistical analysis of pressure drop data for 98 cyclone designs. This model is used with the efficiency model of Iozia and Leith (1990) to develop an optimization curve which predicts the minimum pressure drop on the dimension ratios of the optimized cyclone for a given aerodynamic cut diameter, d_{50}. The effect of variation in cyclone height, cyclone diameter, and flow on the optimization is determined. The optimization results are used to develop a design procedure for optimized cyclones. 33 refs., 10 figs., 4 tabs.

12357 (DOE/PC/90096–1) **Microbial reduction of SO_2 and NO_x as a means of by-product recovery/disposal from regenerable processes for the desulfurization of flue gas: Technical progress report, September 11, 1990–December 11, 1990.** Sublette, K.L. Tulsa Univ., OK (USA). Center for Environmental Research and Technology. [1990]. 61p. Sponsored by USDOE,. DOE Contract FG22-90PC90096. Order Number DE91008406. Source: OSTI; NTIS; GPO Dep.

For the past five years Combustion Engineering (CE) and, since 1986, the University of Tulsa (TU) have been investigating the oxidation of H_2S by the facultatively anaerobic and autotrophic bacterium Thiobacillus denitrificans and have developed a process concept for the microbial removal of H_2S from a gas stream. In 1987/88 we demonstrated that the sulfate reducing bacterium, Desulfovibrio desulfuricans, can be grown anaerobically in mixed, septic cultures using SO_2 and glucose. The simultaneous removal of SO_2 and NO by D. desulfuricans and T. denitrifications co-cultures and cultures in series was demonstrated but is not feasible at this time. Microbial reduction of SO_2 is a viable process concept for by-product recovery from desulfurization. In addition it has also been demonstrated that T. denitrificans can be grown anaerobically on NO(g). Therefore, microbial reduction of NO_x is a viable process concept for the disposal of concentrated streams of NO_x as may be produced by certain regenerable processes for the removal of SO_2 and NO_x from flue gas. Current progress includes work on a number of batch experiments using D. desulfuricans working cultures using municipal sludge as a carbon and energy source. It was found that the addition of yeast extract stimulates H_2S production. 19 refs., 4 figs., 15 tabs.

12358 (SVF–372) **Evaluation of monitoring results and follow-up of NO_x-, N_2O- and SO_2 emissions during extended time periods at an industrial CFB.** Wrangensten, L. (AaF-Energikonsult, Stockholm (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Aug 1990. 88p. (In Swedish). Order Number DE91753077. Source: OSTI; NTIS (US Sales Only).

This is the continuation and second stage of project B7-826, meaning emission tests and measurements of boiler No. 4 at Kopparfors AB. The boiler is a circulating fluidized bed (CFB) with a steam production capacity of 20 kg/s. The test program has been performed during a four weeks period. The following main parameters has been studied to find correlations affecting NO_x-emissions: * O_2 content, * Bottom bed temperature, * Air distribution, primary/secondary air, * Boiler load. As a summary some measures to minimize the NO_x-emissions on year basis are given in priority order: * Improved O_2-control taking CO-emissions into consideration, * Increased flue gas recirculation to obtain a uniform low bed temperature (max. 850 deg C) when operating with different fuel qualities, * 40% primary air when firing fuel mixes and pure wood fuel and observation of high level secondary air influence of cyclon outlet temperatures and NO_x-emissions. (author).

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Refer also to citation(s) 12355, 12653, 12903, 13066, 13419

12359 (SVF–371) **Measures for reducing emissions from a peat fired boiler equipped with a moving grate and flue gas recirculation.** Schuster, R. (Energiteknisk Utveckling AB, Trosa (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Energiteknisk Utveckling AB, Trosa (Sweden). Jun 1990. 199p. (In Swedish). Project SVF-B7-711. (ETU–U7007). Order Number DE91753047. Source: OSTI; NTIS (US Sales Only).

The object of the project was to evaluate the possibilities to reduce the NO_x-emissions for a peat fired boiler by using different fuel qualities, by changing the operating settings and by recirculation of flue gas. About 90 tests were made during 24 days of testing in a 12 MW generator boiler, equipped with a moving grate. The NO_x-emissions varied between 145 to 340 mg/MJ. The evaluation of independent variables showed a decreased NO_x-emission at decreased load, at a decreased share of secondary- and tertiary air and when flue gas was recirculated to the grid. The analysis of the remaining correlations showed that an increased excess air ratio gave an increased NO_x-formation, especially in combination with tests with recirculation of flue gases. A concentrated secondary- or tertiary air supply seems to increase the NO-emissions. Fuel nitrogen content, fuel moisture content, air leakage and air preheating gave no significant effect on the NO_x-formation. The boiler produced very small amount of CO and THC. CO and THC was correlated like CO and NO_x. The emission of SO_2 was on 90% of the theoretical from the fuel sulphur. The N_2O-emissions was between 0 and 27 mg/MJ, with 9 mg/MJ as mean value. The content of N_2O had no strong correlation to the operating settings.

0120 Mining

Refer also to citation(s) 12904

12360 (ETDE-mf–1756514) **Mine climate improvement by face cooling in extremely thin seams. Final report.** Altena, H. Ruhrkohle AG, Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Dec 1989 57p. (In German). Contract BMFT 01 HD 026. Order Number DE91756514. Source: OSTI; NTIS (US Sales Only).

Prototypes of 'cooling shields' and a deep cooling line with 15 'cooling pans' of an AFC were tested. The legs of the cooling shields were arranged asymmetrically so that a forced ventilated ultra-compact cooler may be accommodated. A fan driven by high pressure water using a turbine is used for ventilation purposes. After the successful testing on the surface and underground a suitable face cooler for a 5 kW minimum cooling capacity is available. Though the functionality of the deep cooling line installed between the conveyor pan and the gob side plough guidance of the AFC could be proven on the surface test rig, it is not yet suitable for practical applications underground without further considerable improvements. (orig.) With 7 refs., 1 tab., 13 figs.

12361 (ETDE-mf–1756520) **Development of a computer supported system for prediction of rock pressure and - movement. Final report.** Meyer-Funke, A.G.; Kuczynski, M.; Luetzenkirchen, K. Ruhrkohle AG, Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1990 33p. (In German). Contract BMFT 03E-6304-A. Order Number DE91756520. Source: OSTI; NTIS (US Sales Only).

Multi-seam-mining in great depths creates difficult problems in rock mechanics. To predict pressures enables to plan underground plants in low pressure areas with suitable fit out to minimise damages and costs and to rise safety. A first (test-)model (Bergbauforschung GmbH, Essen, 1970) makes possible rough estimations of rock pressure distributions. On the basis of these experiences of rock pressure distributions. On the basis of these experiences and with usage of most modern hard- and software-technologies, new computer supported models had to be developed to describe geometric and stratigraphical properties of the underground in a more realistic way. Input-dialogs and graphic outputs should make model-using easier. Two models are available: GEDRU1 to predict vertical pressure in large areas with a simplified formular system in rock mechanics, GEDRU9 to predict all components of movements and stresses for special applications under difficult rock mechanics conditions. Modules for input/output are very comfortable. (orig.).

12362 (ETDE-mf–1759398) **Reducing down-times in the face and the road by optimization of the chain welding. Final report.** Becker-Pruente GmbH, Datteln (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Messtechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). [1990] 36p. (In German). Contract BMFT 0326548A. Order Number DE91759398. Source: OSTI; NTIS (US Sales Only).

The weld seams of round steel chains have so far been subjected to random destructive tests. Chain defects - especially weld ruptures and brittle fractures - can actually lead to danger for men and machines in mining and to considerable production losses. As a 100% non-destructive testing is not possible the only remaining option is to optimize the welding process as a whole. This research project provided the possibility of measuring the quality determining parameters e.g. welding flux, welding stress, upset force and upset travel with high temporal resolution for each individual link of the chain. (orig.).

12363 (KTM/E-D–185) **Development of peat production for granulated peat.** Lindh, T. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab.). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. Jun 1990. 114p. (In Finnish). Project KTM-104/881/84. Order Number DE91752992. Source: OSTI; NTIS (US Sales Only).

This R and D project was done during 1985-1988 as cooperational project between Turveruukki Oy and Combustion and Thermal Engineering Laboratory of the Technical Research Centre of Finland. The aim of the methodological developing work was to produce a viable method for production of granular peat under field conditions for gasification and combustion. The existing sod peat machines can be adapted for the production of granular peat with minor constructional changes. The size of the granules is however inconvenient because the removal of fines and impurities is difficult. The product was not clean enough if traditional harvesting and sieving methods are used, although machines for other parts of the production chain were found among the existing machines. According to large drying tests made in the field and in the simulator, the dry matter yield of granules (4-7 days, layer thickness 4-5.0 kg dry matter/m^2, summer 1985 and 1986) is not markedly better than that of other peat products (8-10 days, 8-14 kg dry matter/m^2, summer 1987 and 1988, produced with RNK screw sod peat machine) to compensate the high production costs of granular peat. The main portion of the costs are cutting costs. The equipment development work was concentrated largely on the construction of a high capacity granulation and sod peat machine based on screw cutting. The efficiency of RNK screw sod peat machine is more efficient than earlier sod peat machines, and the quality of sod is better than that of earlier products. R and D work also done in decreasing of energy and power demand of disc cutters, which resulted a new cutting disc of high capacity and low energy demand.

12364 (OY/PSTL-RR–102) **Peat research: Polytechnical Institute of Kalinin and University Oulu.** Soini, E.; Kiukaanniemi, E. (eds.). Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. 44p. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

The report is a summary of papers represented in a seminar arranged at Oulu University, Finland, on 6.4.1990. In order to start a series of seminars on peat instruction and research to be held jointly between the Kalinin Polytechnical Institute in the Soviet Union and the University of Oulu. The seminaar consisted of a general introduction to peat research at the Kalinin Polytechnical Institute and a review of some research projects going on at Oulu University or in other organizations in the Oulu area.

12365 (OY/PSTL-RR–102, pp. 12-19) **On the fundamentals of the spring drying of peat in the field.** Kiukaanniemi, E. (Oulu Univ. (Finland). Research Inst. of Northern (Finland)); Leiviskae, V. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

Peat production outside of the summer season is an interesting topic of research, because the normal summer production season is short, e.g. about three months in Finland. Artificial water extraction methods are one way of making production independent of the weather, another way being more efficient utilization of solar drying. This paper concerns the drying of peat in the field in spring - a time of the year not eploited for peat production at present although it clearly offers some drying potential. Drying tests in the field are discussed and a survey is made of recommended directions for further technical development.

12366 (OY/PSTL-RR–102, pp. 28-31) **Classification of rain parameters for peat production purposes.** Ahonen, A. (Oulu Univ. (Finland). Research Inst. of Northern Finland); Kiukanniemi, E. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

The first aim of this research project was to estimate production losses due to rain. This was done for four peat production sites during summer 1989. The proportion of the production season lost through rain varied in the range 34-39% between the sites and yields during the season would theoretically have been 90-110% higher if there had been no rain. The production season studied was generally regarded as a better one than average, however, so that mean losses would have been somewhat greater than this. Another aim was to classify the types of rainfall experimentally according to their practical effect on field drying. Artificial rain tests were carried out on milled peat samples in the laboratory with a radiation of 640 W/m^2, air stream velocity 1.5 m/s, evaporation 1.2

mm/h and a groundwater table of 50 cm. This research project has provided experimental data on the relation between rain sum and drying time time for the peat qualities occurring most frequently in Finland. Some further experiments will be carried out to enable rain storms to be classified according to their effects and a set of production recommendations will be developed for peat producers to help them to time the production stages in an optimal manner for different types of rainfall.

12367 (OY/PSTL-RR–102, pp. 20-27) **Development of water purification techniques in peat production.** Ihme, R. (Valtion Teknillinen Tutkimuskeskus, Oulu (Finland). Rakennuslaboratorio). Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

The aim of the project 'Development of water purification technology for peat production' was to develop new methods for reducing the pollution load caused by peat production and to improve existing ones. Research work started in 1987, field investigations were performed over three years (1987-1989) and the final report will be ready in 1990. The Ministry of Trade and Industry, peat producers, water conservation authorities and the Building Laboratory of The Technical Research Centre of Finland took part in the implementation of the project. The work is divided into the following topics: use of the surface drainage technique for the purification of runoff water, use of filtration, retention of the load in field drains, and improvement of the functioning and cleaning of sedimentation basins. Tests were carried out at sites in the Province of Oulu.

12368 (OY/PSTL-RR–102, pp. 41-43) **The arithmetic of sod peat drying.** Sohlo, J. (Oulu Univ. (Finland). Dept. of Process Engineering); Pirilae, E. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

A mathematical model was developed to study how different factors affect the drying of sod peat and overall production efficiency, employing as its parameters solar energy flux, temperature, air humidity, diameter and length of sod peat pieces, drying surface and sod peat turning rate. A screw-feed PK-1 sod peat press was built in a laboratory of mass and heat processes. Several series of tests were performed under both field and laboratory conditions to find out how the various parameters affect sod peat drying. The effect of solar energy flux on the drying time was observed to be linear, while the best drying speed per unit mass was attained with pieces of diameter 45 mm. Given a solar energy of 55.2 kWh/m^2 (285 W/m^2/h), the average drying speed of 45 mm sod peat was 28.8 g/h/kg dry weight. Under constant laboratory conditions (400 W/m^2/d, surface temperature 23 deg C) it was measured to be 17.9 g/h/kg dry weight. Sod peat pieces of different sizes were produced (dia. = 100, 80, 70, 55, 45, 35 and 45 x 57 mm) and their drying was monitored in the field in summer and under laboratory conditions in winter. Different shapes were also tested, i.e. grooved, crooved, cracked and star-shaped.

12369 (VTT-OPT–21) **Fast preparation and more accurate utilization of the peat production area (Nova project).** Leiviskae, V. (Oulu Univ. (Finland). Research Inst. of Northern Finland); Kiukaanniemi, E. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1990. 28p. (In Finnish). Project KTM-275/881/87. Order Number DE91752989. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

This report concerns with preconditions of frozen peat production in spring after the melting of snow on the fields. Because the net evaporation is nearly the same in May as during summer months, there are in principle good possibilities for peat production. However, the preconditions are limited by some technical facts such as production technology of fast drying particle size and the carrying capacity of the fields when the frost on soil is thawing. The milling tests in spring 1989 showed, however, that by frost milling we may speed up the start o production season some degree, about one crop cycle. The amount of additional production depends on weather conditions in May. Improving the milling technology especially for frozen peat we expect to be able to increase the yield of frost peat. One important point in this improving process will be the production of particle size with optimal drying properties.

12370 (VTT-OPT–22) **Development of the quality of peat products and the reliability of delivery of them.** Siira, H. (Turveruukki Oy, Rantsila (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1990. 70p. (In Finnish). Project KTM-275/881/87. Order Number DE91752998. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

Sampling of milled peat during stockpiling was studied in Kurunneva peat production area and the sampling of sod peat in Joutenneva area. On the basis of accuracy of the results, the best sampling method would be taking samples from all of the peat loads driven into stockpile, but in practice collecting and analyzing of numerous samples is laborous and hence smaller amounts of samples are used. The most suitable method for storing peat samples is to use airtight cans, filled with peat and equipped with lids. The suitability of microwave technology in moisture measurement of peat was tested in August 1988. The accuracy of the equipment in the case of peat was, however, insufficient, the distribution of the results being 1.5%. Improvement of efficiency of the operation and the profitability of a production chain have been the aims of the research 'analysis of a peat production chain', described in the latter part of this report. The effects of the improvements of the profitability have been studied on the basis of the profit percent of the invested capital. The effects of selling of the machinery on the contractional fees have been estimated using construction model for costs, made by a table operating software. The effect of selling of machinery on profitability is 1-25, while the profitability of the invested capital can be increased up to 10-25% by increasing the hectare yield up to 650 m3 and by selling the machinery. The profitability calculations have been made using two areas, 60 and 120 ha and three different rates of operation. The HAKU, the pneumatic harvester and the collecting trunk methods were studied in the case of milled peat production methods and the HAKU method and collecting trunk in the case of sod peat production.

0130 Transport, Handling, and Storage

Refer also to citation(s) 12276, 12277

12371 (CONF-900858–, pp. 1-8) **Storage, transport and handling of CWF [coal-water-fuel] for small-scale combustors.** Sayre, A.N.; Breault, R.W. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The problems associated with coal-water fuel (CWF) combustion systems at small scales are significant and potentially more difficult to overcome than those associated with large-scale applications. The primary issue that needs to be addressed is the on-off nature of small-scale systems. This one issue has major effects on the requirements of the storage and delivery subsystems. Also important is the need for good atomization in small combustors. This paper addresses these issues, proposes simple solutions to these problems, and substantiates these solutions with recent test data as well as an excess of 500 hours of operating experience on a residential CWF-fired warm air furnace.

12372 (CONF-900858–, pp. 9-15) **Research and development for storage, transport, and handling of coal-based fuels.** Chiang, S.H. (Univ. of Pittsburgh, PA (USA)); Klinzing, G.E.; Cooper, M.H.; Yang, W.C.; Woodle, B.M.; D'Amico, N. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal*

preparation, utilization, and environmental control contractors conference. Proceedings. 604p. Order Number DE91004208. Source: OSTI; NTIS.

Westinghouse Electric Corporation, with the University of Pittsburgh as principal subcontractor, is conducting Research and Development for Storage, Transport, and Handling of Coal Based Fuels under DOE/PETC Contract DE-AC22-89PC89797. The objectives of this program are the development of cost effective systems for the storage, transport, and handling of dry, ultra-fine coal (approximately 10 micron diameter particles). Cost effective systems are necessary for the logistics of this coal form for commercialization of DUC. The project, which was initiated in October 1989, will develop total logistics systems for safe, economic, and environmentally protective storage and delivery of DUC for residential, commercial, and industrial uses. The twenty-four month program includes experimental verification of key features. The status of each technical task is summarized. Preliminary conclusions from the early work performed to date are: inert cover gases will be required for transporting and storing DUC; equipment exists for the rail and truck transport of DUC; and storage and pneumatic transport systems can be developed.

12373 (OY/PSTL-RR–100) **Supervision of peat stockpiles using aerial thermography.** Tervo, M. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. 114p. (In Finnish). Order Number DE91752966. Source: OSTI; NTIS (US Sales Only).

Thus work concerns the technical and economic feasibility of aerial infrared thermography for observing spontaneous heat generation in peat stockpiles. The theoretical section is concerned with the physical basis of heat radiation, the measuring instruments and the special features of aerial infrared thermography. The effects of weather on the resultss of thermography are also discussed. The technical applicability of infrafed thermography was studied by taking about 2 800 thermograms of peat stockpiles during the autumns of 1987-1989 and using these to measure the inside temperatures of 200 stockpiles on peatbogs. These data show that it is possible to observe spontaneous heat generation in peat stockpiles from an aeroplane quite reliably by means of thermograms and that this can be done at an early stage, long before there is any risk of self-ignition. The method is applicable technically to both sod peat and milled peat. A set of recommendations for the aerial thermographing of peat stockpiles is developed, including recommendations on equipment, the thermographing process, the most suitable weather conditions and for interpretation of the thermograms. The costs of aerial thermography are compensated for by savings obtained from the minimization of peat losses due to spontaneous heat generation and fires. If the storage time of the self-heating stockpiles identified by aerial thermography can be made reduced by earlier transporting of the peat to the user, the resulting savings will cover the costs of the thermography. This is shown to have been possible under the circumstances prevailing in autumn 1989.

12374 (OY/PSTL-RR–102, pp. 32-36) **Aerial supervision of peat stockpiles using an infra-red camera.** Tervo, M. (Oulu Univ. (Finland). Research Inst. of Northern Finland). Oulu Univ. (Finland). Research Inst. of Northern Finland. 1990. (CONF-9006322–: Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu, Oulu (Finland), 6 Jun 1990). In *Peat research: Polytechnical Institute of Kalinin and University of Oulu.* 44p. Order Number DE91752967. Source: OSTI; NTIS (US Sales Only).

The selfheating of peat stockpiles causes major economic losses every year. It has been estimated that about 5% of the amount of energy in stored peat is destroyed annually by of selfheating. Aerial thermography is a rapid supervision method which enables stockpiles to be examined thoroughly using a single camera even when spead over a vast area. About 2 800 thermograms of peat stockpiles were taken from an aeroplane during the autumns of 1987-1989 and used to measure the inside temperatures of 200 stockpiles on peat bogs. The pilot navigator of the single-engined light aeroplane watched a real time picture from the infra-red camera on a monitor mounted on the control panel. The picture and voice were recorded on VHS videotape. Stockpiles on 28 peat bogs were thermographed from an aeroplane 3 times during the period 21.8.-23.10.1989, in weeks numbers 34,37 and 42. The total amount of peat under supervision was 1.3 million m^3, 700 000 m^3 sod peat and 600 000 m^3 milled peat and the number of the stockpiles was 562,470 of sod peat and 92 of milled peat. 39 of the 470 stockpiles were suspected to be warming up, and the inside temperatures of 36 of these weere checked in the fied. The maximum inside temperatures of 16 stockpiles were over 50 deg C. The costs of aerial thermography are compensated for by savings obtained from the minimization the selfheating losses and damage due to fires. If the storing time of the selfheated stockpiles identified by aerial thermography can be shortened by transporting the peat to the user earlier, it is possible to cover the costs of the thermography by the energy savings obtained. This has been shown to be possible under the circumstances prevailing in autumn 1989.

0140 Combustion

Refer also to citation(s) 12277, 12325, 12326, 12342, 12346, 12347, 12351, 12358, 12359, 12584, 12650, 12651, 12966, 13240

12375 (CONF-900801–44) **Advanced two-stage combustor.** Rehmat, A.; Khinkis, M. Institute of Gas Technology, Chicago, IL (USA). [1990]. 8p. Sponsored by Ins. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology's (IGT) two-stage combustor promises increased combustion efficiency, greatly reduced formation of NO_x, significantly lower CO, THC, SO_x, and HCl emissions, lower particulate emission, and production of environmentally benign residue (ash, spent sorbent). The first stage of the combustor is a turbulent fluidized bed, which operates under substoichiometric conditions so that the fuel-bound nitrogen is prevented from producing NO_x. Sorbent is injected to promote the capture of sulfur and/or chlorine in solid form. The cyclonic combustor constitutes the second stage of the two-stage combustor. High-intensity, high-efficiency combustion of the reducing gases from the first stage takes place in the cyclonic combustor under conditions that minimize the formation of NO_x while providing low CO and THC emissions. Combustion of a low-Btu gas in the cyclone combustor is described. 6 refs, 3 figs., 4 tabs.

12376 (CONF-900858–, pp. 16-25) **Combustion characterization of beneficiated coal based fuels.** Hargrove, M.J.; Chow, O.K.; Nsakala, N.Y. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objectives of this project include: (1) the development of an engineering data base which will provide detailed information on the properties of approximately fifteen Beneficiated Coal-Based Fuels (BCFs) influencing combustion, ash deposition, ash erosion, particulate collection, and emissions; and (2) the application of this technical data base to predict the performance and economic impacts of firing the BCFs in various commercial boiler designs. The technical approach used to develop the data base includes: bench-scale fuel property, combustion, and ash deposition tests; pilot-scale combustion ash effects and emissions tests; and full-scale combustion tests. Nine fuels have been acquired from PETC and tested. These fuels included Illinois No. 6, Upper Freeport and Pittsburgh No. 8 microbubble flotation products (MFPs), spherical oil-agglomeration products (SOAPs), and their respective parent coals. Since the MFP's were received in wet filter cake form, one was tested as a microfine coal-water fuel (MCWF). The status of the tasks is described and preliminary results are given.

12377 (CONF-900858–, pp. 26-33) **Coal quality effects in combustion systems: Combustion properties of highly cleaned coals.** Smouse, S.M. (Pittsburgh Energy Technology Center, PA (USA)); Wildman, D.J.; McLIvried, T.S. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Developing-advanced-coal-cleaning technologies may allow the low-cost production of highly beneficiated coal-based fuels. To gain the acceptance of the potential industrial and utility users, a detailed analysis of the impact of clean-coal use on overall plant performance and economics is warranted prior to full-scale commercial production. Such evaluations will serve to screen potential coals through the various developing processes and to identify promising technologies for commercialization. In this manner, the commercial value of advanced-coal-cleaning products can be assessed more precisely, and trade-offs among coal preparation, boiler plant operating and maintenance, and flue-gas-cleanup costs made. To address these issues, a multilevel program has been initiated at PETC to identify and quantify specific problems that might limit or impede the use of highly beneficiated coal-based fuels. The clean coal products from several advanced chemical and physical coal cleaning processes have been submitted for low level evaluations. A new 500,000 Btu/hr pilot-scale combustion facility the PETC Fuels Evaluation Facility, has been designed and constructed for more detailed analyses. A micronized low-ash bituminous coal from the Upper Elkhorn No. 2 seam was fired throughout shakedown of the facility. The results presented here on flame stability, slagging, and fouling typify the pilot-scale evaluations to be conducted. As other clean coal products become available, they will be subjected to similar evaluations. Boiler performance and economic modeling of clean coal use in existing power stations has been initiated.

12378 (CONF-900858–, pp. 34-40) **Combustion characterization of low-rank coal fuels.** Gunderson, J.R.; Mann, M.D.; Selle, S.J. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The overall objective of this project is to expand the existing scientific and engineering data base on combustion characterization of advanced low-rank Coal fuel types for combustion systems in the industrial and utility market currently using oil or gas as the primary fuel. To accomplish this purpose, specific objectives are to use laboratory-, bench-, and pilot-scale techniques to characterize various dry and slurried coals and coal blends. Results of these enhanced characterization tests will be used to assess the effect of switching fuels on the ignitability and stability of the flame, carbon burnout, furnace wall slagging, high-temperature fouling, low-temperature fouling, and gaseous and particulate emissions as compared to the design fuel. Work during this year focused on upgrading the EERC ash fouling test furnace into a system capable of characterizing all aspects of combustion. Equipment needed for these tests are described. Results are not as yet available.

12379 (CONF-900858–, pp. 41-47) **Advanced atomization concept for CWF [coal-water fuel] burning in small combustors.** McHale, E.T. (Atlantic Research Corp., Alexandria, VA (USA)); Heaton, H.L.; Lippold, J.H. Jr. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

A major problem impeding wider utilization of coal-water fuel (CWF) is lack of an atomizer suitable for firing small-scale boilers with capacities of 2 - 20 MMBTU/H. The objective of the present study is to develop an atomizer, based on a new concept, that will produce substantially finer droplets, in the 20 micron range. The device employs two diametrically opposed jets of CWF which impinge on each other at high velocity. An air blast is directed at the impact zone of the two jets and the resulting high energy collision of all streams serves to break up the slurry fuel into fine droplets. Parameters which have been investigated include CWF and atomizing air jet size, distance and velocity, as well as atomizing air/fuel ratio. Based on the cold flow results with the prototypes, an atomizer has been fabricated for use in a 1 MMBTU/H research tunnel-type furnace. The test furnace is equipped with means to preheat CWF and secondary air and to monitor flow rates of both. The secondary air enters the furnace through a diffuser that imparts high swirl. A complete complement of gas analyzers and an isokinetic sampler are attached to the stack for measurement of combustion performance. Parameters covered in the testing included CWF firing rate, atomizing air pressure, secondary air preheat temperature, secondary air diffuser design, CWF viscosity and solids content, CWF preheat temperature, and coal type. The effects of these parameters on combustion efficiency have been determined. In this report, data previously obtained are summarized, together with results obtained since the Contractors' Meeting of 1989. In addition, work to be performed under Phase 11 of the program is described.

12380 (CONF-900858–, pp. 81-88) **Superclean coal-water slurry combustion testing in an oil-fired boiler.** Miller, B.G. (Pennsylvania State Univ., University Park (USA)); Scaroni, A.W. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The Pennsylvania State University is conducting a superclean coal-water slurry (SCCWS) program to show that SCCWS (a fuel containing coal with less than 3.0% ash and 0.9% sulfur) can effectively be burned in oil-designed industrial boilers without adverse impact on boiler rating, maintainability, reliability, and availability. The project will provide information on the design of new systems specifically configured to fire these clean coal-based fuels. The project consists of three phases: (1) design, permitting, and test planning, (2) construction and start up, and (3) demonstration and evaluation. The boiler testing will determine if the SCCWS combustion characteristics, heat release rate, fouling and slagging factors, corrosion and erosion limits, and fuel transport, storage, and handling can be accommodated in an oil-designed boiler system. In addition, the proof-of-concept demonstration will generate data to determine how the properties of SCCWS and its parent coal affect boiler performance. Economic factors associated with retrofitting and operating boilers will be identified to assess the viability of future oil-to-coal retrofits. The project has progressed from the engineering design phase through the bidding phase and contracts for the building construction and boiler installation were awarded. Major pieces of equipment and systems are described.

12381 (CONF-900858–, pp. 96-104) **Combustion of pulverized coal in counter-current flow.** Goldman, Y. (Technion - Israel Institute of Technology (Israel)); Timnat, Y.M. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The objective of the study is to develop and investigate two prototypes of pulverized coal combustors operating in counter-current flow. In the first year of the project the activity was focused on: (a) design, calculation and fabrication of a prototype of the combustor for atmospheric pressure operation, (b) purchase and fabrication of the measuring instruments and preparation of the facilities for experiments, (c) performing the experiments with the combustor firing bituminous coals (including coal samples delivered from the USA), and (d) theoretical - predictive work. According to initial experimental results obtained in a previous study of combustor performance (Hazanov et. al. 1989), the current research proposes a theoretical/numerical model for predicting the behavior of coal particles in the combustor. The configuration considered is eight times larger by volume and arranged vertically to improve ash separation within the chamber. Attention was focused on particle trajectories, burn-out, angle of injection, ash separation by rotational movement, effects of initial particle size and temperature, impingement velocity and gravity. Results to date are described and future plans are explained.

12382 (CONF-900858–, pp. 104-110) **A vortex combustor for glass melting.** Hnat, J.G. (Vortec Corp., Collegeville, PA (USA)); Talley, W.F.; Bartone, L.M.; Myles, P.T. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation,*

utilization, and environmental control contractors conference. Proceedings. 604p. Order Number DE91004208. Source: OSTI; NTIS.

The research efforts by Vortec are being directed toward the development of an efficient, coal-fired process heater which can be used for glass melting as well as other high temperature industrial applications, e.g., hazardous waste incineration/vitrification and the recycling of several types of glass containing industrial wastes. The objective of Phase I was to verify the technical feasibility and economic benefits of Vortec's advanced glass melting technology using coal as the primary fuel. This phase involved the design, fabrication, installation and operation of a pilot scale test loop. Conceptual designs of commercial scale glass melters were developed, and techno-economic analyses were performed to validate the commercialization potential of the basic process heater concept. The primary objective of the Phase II effort is to improve the performance of the primary components and demonstrate the effective operation of a subscale process heater system integrated with a glass separator/reservoir. A variety of coals will be tested. The impact of coal ash on glass production quality will be assessed and the melting of more complex glasses and other vitrifiable waste materials will be investigated during this phase. The current status and preliminary results are described.

12383 (CONF-900858–, pp. 111-117) **Advanced coal-combustion system for retrofitting oil/gas-designed industrial boilers.** Wagoner, C.L. (Univ. of Tennessee Space Institute, Tullahoma (USA)); Foote, J.P.; Attig, R.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

A four-year, two-phase DOE-sponsored contract with the University of Tennessee Space Institute (UTSI) is well along the way toward completion. The objective of this work is to develop an advanced coal combustion system to allow industrial firetube boilers to use dry, ultrafine, cleaned coal to replace to replace oil, propane, or natural gas design-fuels. The system is to be suitable for retrofit of existing boilers or application in new designs. A commercialization study will be included in future work.

12384 (CONF-900858–, pp. 118-125) **Development of a pulse coal combustor for industrial retrofit applications.** Mansour, M.N.; Chandran, R.R.; Duqum, J.N.; Shekarchi, S.; Durai-Swamy, K.; Gyorke, D.F. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

In Phase 1, a tandem slagging pulse coal combustion system was developed and optimized at the laboratory-scale (2 MMBtu/hr) for firing dry coal fuels. The system exhibited 99+ percent combustion efficiency and greater than 90 percent ash rejection efficiency. When coal-water slurry (CWS) fuels were fired, varying amounts of support gas were required depending on the slurry used. Sulfur capture by sorbents such as lime and limestone were also investigated. The subsequent Phase IA involved scale-up to 3.5 - 5 MMBtu/hr firing rate, boiler integration and extensive testing with CWS fuels. The pulse combustion system was operated over a range of test conditions, including different firing levels, CWS injector designs, injector locations, atomizer tips, and stoichiometries. The objective of Phase II, now in progress, is to carry out pilot-scale demonstration (15 MMBtu/hr firing rate) of a pulse coal combustor fired with dry, pulverized coal for industrial boiler and process heater retrofit applications. The approach, current status and future plans are discussed in the following sections.

12385 (CONF-900858–, pp. 126-134) **Plasmatron ignitor for residential combustors.** Hruby, V.J.; De Saro, R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The primary objective of this program is to develop a plasma based electrical ignition system (Plasmatron) for a coal-water slurry (CWS) residential size combustor (100,000 Btu/hr). This overall objective is divided into three segments: (1) To demonstrate the feasibility of the Plasmatron as a CWS ignitor and flame stabilizer; (2) To construct an experimental test facility including a single-stage CWS combustor to evaluate performance of the Plasmatron; and (3) To perform an operational test of the Plasmatron device using Energy and Environmental Research Corporation (EER) designed CWS combustor appropriately modified to accept the Plasmatron. The status of the technical tasks is described.

12386 (CONF-900858–, pp. 135-142) **Development of a vortex combustor for commercial space/water heating applications.** Nieh, S. (Catholic Univ. of America, Washington, DC (USA)); Fu, T.T. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Since the energy crisis in the early 1970's, the increase in oil prices and the concerns of oil shortage in the near future have prompted an interest in coal as a replacement fuel for space heating, water heating, and process heat. Advanced coal combustion technologies engineered for small- and medium-scale applications are needed to help achieve the nation's set goal of coal utilization. In this paper, a novel non-slagging vortex combustor (vc) firing coal-derived fuels in both powder form and slurry form was developed for commercial heating applications. Results are discussed for cold flow tests, combustion tests, and mathematical modeling.

12387 (CONF-900858–, pp. 143-150) **CWS [coal water slurry]-fired residential warm-air heating system.** Balsavich, J.C. Jr. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The overall objective of this research program was to develop an economically viable, CWS-fired furnace competitive in size, performance, reliability, and ease of operation with respect to present oil- and gas-fired systems. During the course of this program, three furnace systems were designed, constructed, and tested. These systems ranged from a first-generation system which served as a proof-of-concept unit, to a second-generation laboratory test and optimization unit, and finally to a third-generation, preproduction prototype unit which was tested extensively and demonstrated the technical feasibility of the CWS furnace. At the heart of each of the furnace systems was a novel CWS combustor rated for operation at an input rate of 100,000 Btu/hr. The combustor makes use of a centrifugal force field, established by a predominately vortical flow field to separate and detain larger CWS droplets. Multiple partition plates are used to retard the axial downward flow of particles and thus maximize their residence time in the hottest section of the combustor. The zones established by the multiple partition configuration allow the unit to be operated as a staged combustor. The unit produces combustion efficiencies in excess of 99 percent, response to full load from a cold start in less than 5 minutes, and a turndown ratio on excess of 3:1. In addition to the combustor, the entire CWS furnace system has also met or exceeded the program criteria including steady state thermal efficiencies in excess of 80 percent and a space requirement of 13 square feet of floor space and 5.5 feet high. This paper describes recent testing conducted on the third-generation furnace system. In particular, the results of 200 hours of life testing conducted on the furnace as well as the results of 54 hours of cyclic testing are presented.

12388 (CONF-900858–, pp. 151-158) **Radiative heat transfer in PC [pulverized coal] furnaces burning deeply cleaned coals.** Ahluwalia, R.K. (Argonne National Lab., IL (USA)); Im, K.H. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth*

annual coal preparation, utilization, and environmental control contractors conference. Proceedings. 604p. Order Number DE91004208. Source: OSTI; NTIS.

A three-dimensional spectral radiation transport model has been developed for assessing the impact of burning deeply cleaned coals on heat absorption patterns in pulverized coal (PC) furnaces. Spectroscopic data are used for calculating the absorption coefficients of participating gases. Mie theory is invoked for determining the extinction and scattering efficiencies of combustion particulates. The optical constants of char, ash and soot are obtained from dispersion relations derived from reflectivity, transmissivity and extinction measurements.

12389 (CONF-900859–3) **Combustion of high-sulfur coal and anthracite wastes in a rotary kiln combustor with an advanced internal air distributor.** Cobb, J.T. Jr. (Pittsburgh Univ., PA (USA)); Ahn, Y.K.; Angelo, J.F. Riley (Ann) and Associates Ltd., Washington, DC (USA). [1990]. 15p. Sponsored by USDOE,. DOE Contract FG22-90PC90169. From 7. U.S./Korea workshop on coal utilization technology meeting; Pittsburgh, PA (USA); 26-31 Aug 1990. Order Number DE91008547. Source: OSTI; NTIS; GPO Dep.

Fluid bed combustors have received extensive testing with both high-sulfur coal and anthracite wastes. Rotary kilns are effective and popular devices for waste combustion. The Angelo Rotary Furnace™ has been developed to improve the operation of rotary pyrolyzer/combustor systems through enhanced air distribution, which in this process is defined as staged, swirled combustion air injection. Fourteen of these new furnaces have been installed worldwide. Two units in Thailand, designed for rice hull feed with occasional lignite feed, have been recently started up. An older unit in Pennsylvania is being upgraded with a new, more advanced air distribution system for a series of tests this fall in which inexpensive high-sulfur coal and anthracite wastes will be fired with limestone. The purposes of these tests are to determine the burning characteristics of these two fuels in this system, to discover the Ca/S ratios necessary for operation of a rotary kiln combusting these fuels, and to observe the gas-borne emissions from the furnace. An extensive preliminary design study will be performed on a commercial installation for combustion of anthracite wastes. 14 refs., 5 figs., 1 tab.

12390 (CONF-910424–3) **Hydrodynamic scale-up of circulating fluidized beds.** Chang, Hongder; Louge, M. Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering. [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88929. From 11. international conference on fluidized bed combustion; Montreal (Canada); 21-24 Apr 1991. Order Number DE91008404. Source: OSTI; NTIS; GPO Dep.

The effects of scale-up on the hydrodynamics of circulating fluidized beds (CFB) are investigated using a single cold laboratory facility with the ability to recycle fluidization gas mixtures of adjustable kinematic viscosity. Tests are conducted with a plastic powder and glass beads to simulate the high-temperature fluidization in CFB risers of 0.32 and 0.46m diameter, respectively. The hydrodynamic simulation is achieved by matching five dimensionless parameters. Particular care is taken to eliminate electrostatics from the bed using traces of an anti-static additive. Comparisons of the vertical static pressure profiles obtained with the plastic and glass powders indicate that the dimensional analysis yields the correct analogy for the global hydrodynamics of CFB risers. 18 refs., 6 figs., 1 tab.

12391 (DOE/PC/89776–T1) **Effects of calcium magnesium acetate on the combustion of coal-water slurries: Fifth quarterly project status report, 1 September 1990–30 November 1990.** Levendis, Y.A. Northeastern Univ., Boston, MA (USA). Dept. of Chemical Engineering. [1990]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89776. Order Number DE91008432. Source: OSTI; NTIS; GPO Dep.

The general objective of the project is to investigate the combustion behavior of single and multiple coal-water slurry particles burning at high temperature environments. Both uncatalyzed as well as catalyzed CWS drops with Calcium Magnesium Acetate (CMA) catalyst will be investigated. Emphasis will also be given in the effects of CMA on the sulfur capture during combustion. To help achieve these objectives the following project tasks were carried over this 5th three-month period. Work on the construction and interface of the optical pyrometer was continued over this period. Specifically, the following tasks were undertaken: improvements in the optics, development of the pyrometer electronics, construction of the pyrometer containment box, arrangement of the cable connections to the computer terminal, and development of the data acquisition system (both hardware and software.) 6 figs.

12392 (DOE/PC/90169–T1) **Coal desulfurization in a rotary kiln combustor: Quarterly report No. 2, July 1, 1990–September 30, 1990.** Cobb, J.T. Jr. BCR National Lab., Pittsburgh, PA (USA). 3 Jan 1991. 31p. Sponsored by USDOE,. DOE Contract FG22-90PC90169. Order Number DE91008486. Source: OSTI; NTIS; GPO Dep.

During the months of July, August, and September 1990, six major areas have received attention from the project team. They are: background discussions, process analysis, equipment evaluations and actions, environmental issues, presentations, and future planning.

12393 (DOE/PC/90751–T6) **Transformations of inorganic coal constituents in combustion systems: Quarterly report No. 14, January 1–March 31, 1990.** Boni, A.A. (PSI Technology Co., Andover, MA (USA)); Helble, J.J.; Srinivasachar, S.; Wilemski, G.; Sarofim, A.F.; Beer, J.M.; Peterson, T.W.; Wendt, J.O.L.; Huffman, G.P.; Huggins, F.E. PSI Technology Co., Andover, MA (USA). May 1990. 87p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-86PC90751. (PSI–1024;TR–1027). Order Number DE91008940. Source: OSTI; NTIS; GPO Dep.

The technical objectives of this project are to define the partitioning of inorganic constituents associated with raw coal particles among products and to characterize the resultant spectrum of products in detail; to elucidate and quantify the fundamental processes by which transformations of the inorganic constituents occur; and to develop a model capable of predicting the significant features of the transformation process. This report represents work accomplished during the fourteenth quarter of this project. During this quarter a large fraction of time was spent preparing and submitting the Phase 1 Final Report for this contract. Only recent work not discussed in that document is reported herein. The work discussed herein highlights recent accomplishments: on completing analysis of samples submitted by the University of Arizona and PSI Technology Company during the preceding year; on examining the influence of various parameters on char fragmentation, using the code developed during this project; on modeling experimental data describing the liberation of volatile sodium to the vapor phase; and on the adaptation of the MIT mineral redistribution code to provide a basis for development of an ash particle size and composition engineering model. 6 refs., 37 figs., 20 tabs.

12394 (DOE/PC/90751–T7) **Transformations of inorganic coal constituents in combustion systems: Quarterly report No. 15, April 1–June 30, 1990.** Boni, A.A. (PSI Technology Co., Andover, MA (USA)); Helble, J.J.; Srinivasachar, S.; Wilemski, G.; Sarofim, A.F.; Beer, J.M.; Peterson, T.W.; Wendt, J.O.L.; Huffman, G.P.; Huggins, F.E. PSI Technology Co., Andover, MA (USA). Aug 1990. 151p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-86PC90751. (PSI–1024;TR–1027). Order Number DE91008941. Source: OSTI; NTIS; GPO Dep.

This report summarizes work accomplished during the fifteenth quarter of this project. During this time, progress was made in identifying suitable coal samples for study in this continuation of the work. The work discussed herein highlights recent accomplishments: in performing Moessbauer analysis on several Phase 1 program coals to test for weathering, and on recent XAFS analysis of cascade impactor ash samples; in examining the vaporization and recondensation of several elements from 90 to 105 μm synthetic chars in the laboratory drop tube reactor; in (1) comparing PSIT and UA ash particle size distributions for small (<10 μm) ash particles, (2) examining the effects of combustion scale on ash particle size and chemistry, (3) examining trace element release through a study of neutron activation analysis data for several program coals; and (4) continued development of the engineering model for ash particle formation. 11 refs., 72 figs., 26 tabs.

0150 Economic, Industrial, and Business Aspects

12395 (ETDE-mf–1754952) **Rheinbraun business report 1989.** Rheinbraun AG, Koeln (Germany, F.R.). 1990 37p. (In German). Order Number DE91754952. Source: OSTI; NTIS (US Sales Only).

The Rheinbraun business report 1989 contains a large amount of illustrated information (coloured photographs, tables, diagrams) on business development, -result, investment, financing, research and development, personnel, social issues. The board of directors' report deals with: mining activities (open-pit mining, drilling, water management, acquisition of real estate, resettlement programmes, recultivation, landscaping, mining abroad, raw materials), coal upgrading (products, enterprises), environmental protection (noise and dust pollution control, reduction of nitric oxides, fluidised bed combustion). The supervisory board's report gives an overview of participations and allied companies of the Rheinbraun AG in Cologne. (HWJ).

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 12638, 12901

12396 (DOE/EIA-M–042(90)) **Reserves Information Gathering System user's guide: Respondent user's guide for Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," survey year 1990.** USDOE Energy Information Administration, Washington, DC (USA). 17 Jan 1991. 66p. Sponsored by USDOE,. Order Number DE91008037. Source: OSTI; NTIS; GPO; GPO Dep.

The Reserves Information Gathering System, hereafter referred to as RIGS, is an advanced electronic data entry product developed by the Department of Energy as a more efficient, accurate, and timely alternative for submission of Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves" to the Energy Information Administration (EIA). Use of RIGS software is voluntary. The IBM compatible computer was chosen as the hardware component of RIGS because of its wide availability. Error messages are designed to prevent inadvertent entries, and help screens and messages answer most on-line questions that may arise. Company and state/state subdivision totals can be automatically generated, and print functions are available to produce hard copy of an individual group and/or total fields reported.

12397 (DOE/NV/10338–1) **Hydrocarbons associated with brines from geopressured wells: Annual report for fiscal 1989.** Keeley, D.F.; Meriwether, J.R. University of Southwestern Louisiana, Lafayette, LA (USA). [1989]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS07-83NV10338. Order Number DE91008521. Source: OSTI; NTIS; GPO Dep.

The purpose of this research is to determine the concentration of the cryocodensates in fluids of the various USDOE Geopressured wells a function of production volume. To correlate the production of these compounds with reservoir and well production characteristics. To precisely measure solubilities of cryocodensates components in water and sodium chloride solutions (brines) as a function of ionic strength and temperature and the component's distribution coefficients between these solutions and oil. To monitor the wells for the production of aliphatic oils and relate any such production with the cryocondensate yields. To develop models of the geopressured reservoirs which are consistent with the data obtained. To develop a harsh environment pH probe for use in well brines at surface temperatures and pressures. This report discusses progress over the past year in each area of research.

12398 (IFP–38390) **Application of data analysis to petroleum exploration. Seismic facies recognition by multivariate statistical analyses.** Fournier, F. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Institut National Polytechnique, 54 - Nancy (France). Jul 1990. 517p. (In French). Order Number DE91757842. Source: OSTI; NTIS (US Sales Only).

This work presents a stratigraphic interpretation of seismic data and more precisely a methodology for automatic facies recognition analysed on a time window. Applications treated concern, lithologic characterization of series for reservoir studies. Seismic traces contain geologic information that can be extracted by multivariate data analysis of a large number of seismic parameters. Automatic facies recognition is fast and reliable.

12399 (SAND–90-0191C) **Prediction of subsidence resulting from creep closure of solutioned-mined caverns in salt domes.** Neal, J.T. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910544–1: 4. International Association of Hydrological Sciences conference, Houston, TX (USA), May 1991). Order Number DE91000407. Source: OSTI; NTIS; GPO Dep.

The prediction of subsidence rates over a range of areal configurations of solution-mined caverns in salt domes is possible, based on some fifty years of history in solution mining. Several approaches contribute to predictions: site-specific observations obtained from subsidence monitoring; numerical modeling, now becoming more practicable and credible; salt-creep data from testing; and rule-of-thumb methods, based on experience. All of these approaches contribute to understanding subsidence but none are totally reliable alone. The example of subsidence occurring at the Strategic Petroleum Reserve sites demonstrates several principles of cavern creep closure, the main cause of the subsidence, and shows that reliable projections of future subsidence are possible. 13 refs., 6 figs.

0203 Drilling and Production

Refer also to citation(s) 12775, 13124, 13241, 13242

12400 (IFP–38493) **Study of formation and inhibition of barium sulfate deposits in oil-fields. Application to the Algerian field Tin Fouye Tabankort.** Messaoudene, N. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Institut National Polytechnique, 31 - Toulouse (France). Oct 1990. 184p. (In French). Order Number DE91757841. Source: OSTI; NTIS (US Sales Only).

The aim of this work is the study of deposition-corrosion phenomena observed in water injection produced by incompatibility of formation water and injected water and research of an inhibitor adapted to specific conditions of the oil deposit of Tin Fouye Tabankort (Algeria). After a bibliographic study of nucleation mechanisms, crystal growth and inhibition of barium sulfate deposits, an experimental study is carried out to select a polyacrylate with a molecular weight of about 2000 at a concentration of 10 to 50 ppm as inhibitor. Results are confirmed by a pilot injection test in the oilfield.

12401 (NEI-NO–115) **Mineral deposition during oil recovery: An equilibrium model.** Haarberg, T. Trondheim Univ. (Norway). Norges Tekniske Hoegskole. 1989 156p. Order Number DE91746289. Source: OSTI; NTIS (US Sales Only).

A scale prediction model for the minerals $CaCO_3$, $BaSO_4$, $SrSO_4$, and $CaSO_4{*}2H_2O$ on chemical equilibrium basis is developed. Two different activity coefficient models are compared, and the Pitzer model is found to give the best representation of experimental solubility data. The proposed solubility model gives a reliable description of experimental data up to high concentration in the temperature range 0 - 175°C and pressure range 0 - 400 bars. A mathematical model for the simultaneous precipiation/dissolution of scale forming minerals is developed, and by combining the solubility model and the mathematical model, a reliable scale prediction model based on chemical equilibrium is established. The behavior of the carbontate system (pH varations, $CaCO_3$ precipiation) can be predicted if the partial pressure of CO_2 is known, and also in situations where the P_{CO_2} is unknown, by introducing the mass balance for CO_2. By using a commercial reservoir simulator for the transport of water and oil in an oil reservoir during water flooding operations, mineral deposition phenomena in the reservoir are simulated. An important application of the proposed chemical equilibrium model is to use it as an integrated part in a total scale prediction model including chemical equilibrium, reaction kinetics and flow dynamics. The total scale prediction model can be used

to give reliable predictions on the amount and location of deposited minerals in the production system. 174 refs.

12402 (NIPER–522-Vol.2) **National Institute for Petroleum and Energy Research quarterly technical report for October 1–December 31, 1990: Volume 2, Energy production research.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Feb 1991. 89p. Sponsored by USDOE,. DOE Contract FC22-83FE60149. Order Number DE91008824. Source: OSTI; NTIS; GPO Dep.

The following research programs from the National Institute for Petroleum and Energy Research (NIPER) are briefly reported on: reservoir assessment and characterization; TORIS research support; development of improved microbial flooding methods; development of improved surfactant flooding methods; development of improved alkaline flooding methods; development of improved mobility control methods; gas-miscible displacement; development of improved immiscible gas displacement methodology; three-phase relative permeability; thermal processes for light oil recovery; thermal processes for heavy oil recovery; imaging techniques applied to the study of fluids in porous media; microbial enhanced waterflooding field project; technical analysis for underground injection control; developing a reservoir data base: Phase 1; EOR incentive projects survey; feasibility study of heavy oil recovery in the mid-continent region (Oklahoma, Kansas, Missouri); IPRs for slanted and horizontal wells producing from heterogeneous reservoirs; surfactant-enhanced alkaline flooding field project; development of methods for mapping distribution of clays in petroleum reservoirs; identification of cross-formational flow in multi-reservoir systems using isotopic techniques (Phase 1); and summary of geological and production characteristics of Class 1, unstructured, deltaic reservoirs.

0204 Processing

Refer also to citation(s) 12772, 12988, 12999

12403 (ETDE-mf–1756176) **VCC-plant with reduced capacity. Final report.** Frohnert, H.; Uckermann, B.; Vangilbergen, G.; Schulte, H.; Kadow, K.D. Veba Oel Technologie GmbH, Gelsenkirchen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1990 119p. (In German). Contract BMFT 0326566A. Order Number DE91756176. Source: OSTI; NTIS (US Sales Only).

Loose-leaf edition.

During the pre-engineering phase of the VCC-Ruhr-Project the data for a VCC-plant with a capacity of 1.5 Mio t/a vacuum residue were evaluated. Due to the development of the oil prices on the international market the project was not profitable and therefore no realization took place. Based on the above, the variant with a capacity of 0.5 Mio t/a and investment cost of 500 Mio DM was developed. The investment costs are in the magnitude of a normal refinery investment. Also, common facilities of the Scholven-Refinery will be utilized in order to reduce investment cost. The study is devided in two phases: I: Determination of the process concept, II: Basic engineering. The aim of this study is to present an investment cost estimate with an accuracy of ± 20%. This is the bases for an economic comparison. It can be conclused that an economic design and operation of the VCC-plant with a capacity of 0.5 Mio t/a is possible. (orig.) With 20 tabs., 14 figs.

0207 Economic, Industrial, and Business Aspects

12404 (CEC–91008892) **California Energy Commission quarterly oil report, second quarter 1990: Volume 10, No. 2.** Trenschel, D. (ed.). California Energy Commission, Sacramento, CA (USA). Jan 1991. 57p. Sponsored by California Energy Resources Conservation and Development Commission, Sacramento, CA (USA). Source: OSTI; California Energy Commission, Publication Unit, 1516 Ninth Street-MS 13, Sacramento, CA 95814.

This report contains information and data pertaining to the petroleum industry of California. Topics covered include petroleum fuels market activity, price trends, refinery activities, production, and oil company revenues. 11 figs., 6 tabs. (SM)

12405 (CMI-R–90/A30007) **The value of the oil of the fields included in natural gas contracts.** Stensland, G. Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway). Jul 1990. 29p. (In Norwegian). Order Number DE91753005. Source: OSTI; NTIS (US Sales Only).

The report discusses how the value of the oil production from fields included in gas contracts should be calculated. The main conclusion is that if this value is to be used as part of criterion for choice of fields for supply of a gas contract, the value of the oil should be compared with the value of the best alternative development. 17 refs.

12406 (DOE/EIA–0109(91/02)) **Petroleum supply monthly, February 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. Feb 1991. 151p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008858. Source: OSTI; NTIS; GPO; GPO Dep.

Data presented in the Petroleum Supply Monthly (PSM) describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in Primary Supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics. Explanatory Notes, located at the end of this publication, present information describing data collection, sources, estimation methodology, data quality control procedures, modifications to reporting requirements and interpretation of tables. Industry terminology and product definitions are listed alphabetically in the Glossary. 12 figs., 54 tabs.

12407 (DOE/EIA–0380(91/03)) **Petroleum marketing monthly, March 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 8 Mar 1991. 178p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009301. Source: OSTI; NTIS; GPO; GPO Dep.

This report is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 55 tabs.

12408 (DOE/EIA–0520(91/02)) **International petroleum statistics report, February 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 27 Feb 1991. 56p. Sponsored by USDOE,. Order Number DE91008479. Source: OSTI; NTIS; GPO; GPO Dep.

This report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e. non-communist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years.

12409 (DOE/EIA–0538(90/91-21)) **Winter fuels report, week ending February 15, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 21 Feb

1991. 65p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009577. Source: OSTI; NTIS; GPO; GPO Dep.

This report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and state and local governments on the following topics: distillate fuel oil net production, imports and stocks for all PADD's and product supplied on a US level; propane net production, imports and stocks for Petroleum Administration for Defense Districts (PADD) 1, 2, and 3; natural gas supply and disposition and underground storage for the United States and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those states participating in the joint Energy Information Administration (EIA)/ State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United States and selected cities; and US total heating degree-days by city. 34 figs., 12 tabs.

12410 (DOE/EIA–0538(90/91-25)) **Winter fuels report, week ending March 15, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 21 Mar 1991. 66p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009631. Source: OSTI; NTIS; GPO; GPO Dep.

This report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and state and local governments on the following topics: distillate fuel oil net production, imports and stocks for Petroleum Administration for Defense Districts (PADD) 1, 2 and 3; natural gas supply and disposition and underground storage for the United State and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those states participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United states and selected cities; and US total heating degree-days by city. 34 figs., 12 tabs.

0208 Waste Management

Refer also to citation(s) 12346, 12403

12411 (ENET–8700316/1) **Further development of the FUMEX process for desulphurizing and recovering heat from flue gases with a view to achieving continuous operation, even in the case of continuously operating boiler plants in industry and district heating stations.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Dec 1989. 35p. (In German). Order Number DE91749223. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Based on the previous NEFF Projects 253 and 253.1, the processing operations of the FUMEX plant at Knorr-Naehrmittel in Thayingen were optimized to such an extent, that, even under extreme load fluctuations and difficult operating conditions, trouble-free operation and consistently high filtration efficiency can be guaranteed. In connection with the temporary dumping approval, ways subsequently had to be found of delivering the gypsum, obtained from desulphurization, to the adjacent cement works for recycling. One of the important elements of this project was, therefore, the development of a downstream process in order to obtain the right gypsum composition for a cement works. figs., tabs.

12412 (NEI-FI–127) **Desulphurization with lime and catalyst of flue gases from combustion of heavy fuel oil in small boilers.** Kouvo, P. (Enconsults Oy, Turku (Finland)); Pyykkoenen, A.; Kaukanen, E. Aabo Akademi, Turku (Finland). 1990. 62p. (In Finnish). Project KTM-122/881/88. Order Number DE91752997. Source: OSTI; NTIS (US Sales Only).

LIEKKI Research Programme.

In this project the feasibility of effecivated limestone injection to small boilers fired with heavy fuel oil has been examined. The project consists of three parts; a litterature survey, laboratory tests and boiler tests. The laboratory tests were carried out on an isothermic flow reactor of Technical Research Centre of Finland. The boiler tests were made on the 8 MW test boiler at the combustion laboratory of Neste. The test results indicate that, with effecivated limestone injection it is possible to achieve over 60% sulphure dioxide reduction in combustion of normal sulphur heavy fuel oil, with Ca/S mole ratio 3 and 5% of lime amount NaOH addition. All the additives, Na_2CO_3, MgO, NaOH, tested improved the rate of calcium utilization. The best rate of utilization 18,8%, was achieved when NaOH was feeded 6,8% of the injected lime amount with Ca/S mole ratio 2. The problem with the operation of effecivated limestone injection is the heavy fouling of the boiler. The fouling can be reduced by adding for example quartzsand to the lime. The estimated cost of desulphurization with effecivated limestone injection is 20 mk/MWh for a 15 MW boiler fired with heavy fuel oil in the peak use of 2500 h/a.

0209 Environmental Aspects

Refer also to citation(s) 13149

12413 (IKU-R–34.2847.00/02/90) **Reduced emissions of greenhouse gases from offshore production platforms.** Holt, T.; Lindeberg, E.G.B. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Mar 1990. 29p. (In Norwegian). Order Number DE91753015. Source: OSTI; NTIS (US Sales Only).

Burning of natural gas in flares and use of gas in the operation of turbines in the oil and gas production offshore, have been analyzed to find methods to reduce the emission of greenhouse gases, in particular CO_2. An examination of the various sources of the flare gas shows that the continuous emissions of natural gas into the flare during normal operation can be eliminated by replacing the natural gas by inert gas (nitrogen). A new concept to supply existing and future offshore production platforms with electric power from land has been launched. This will eliminate all emissions from the turbines. If the power is transported as direct current, even the platforms most distant from the shore may be supplied with electric power of almost 100% availability. The cost of this power is calculated to be of the same size as the cost of today's offshore power. The concept also implies reduced platform weight of existing platforms, and future platforms may be given a considerably simpler design. 13 refs., 2 figs., 5 tabs.

12414 (STF–21A90049) **The oil spill in Prince William Sound, Alaska.** Christie, H.; Foeyn, L.; Halmoe, G.; Leinaas, H.P. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Jun 1990. 51p. (In Norwegian). Order Number DE91753011. Source: OSTI; NTIS (US Sales Only).

The report gives an evaluation of the clean-up work after the Exxon Valdez oil spill. Further, it gives an evaluation of the research plan attached to the fate of the oil in the nature, the effects on biological resources and the socio-economic impacts. Proposals for Norwegian follow-up initiatives are given. 27 refs., 3 figs.

12415 (SVF–369) **NO_x measurements at oil fired boilers at Vaertaverket (Stockholm).** Hjelm, K. (Stockholm Energi Produktion AB (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Feb 1990. 59p. (In Swedish). Order Number DE91753056. Source: OSTI; NTIS (US Sales Only).

This report describe emission measuring of nitrogen dioxide and nitrous oxide in flue gases from oil fired boilers located at the plant of Vaertaverket. The emission measuring was carried out during November and December 1988. Totally six boilers were investigated, with nominal thermal effects of 2*110 MW, 2*150 MW, 160 MW and 23 MW. The tests included changing of, the combustion air flow, the pressure of atomizing steam to oil burner and the temperature of combustion air, at different boiler loads. The emission of NO_x from the boilers at max.cont. load, reaches contents between 150 mg/MJ and 180 mg/MJ. The emission of NO_x depend greatly of the boiler load. Test with one of the boiler raised the content of NO_x from 90 mg/MJ to 180 mg/MJ when changing the boiler load from low to max.cont. load. Reducing the amount of combustion air caused almost a linear relation between the content of NO_x and oxygen in flue gases.

0230 Properties and Composition

12416 (IFP–38184) **Macrostructure of petroleum asphaltenes behavior in natural medium and in solution.** Herzog, P. Paris-6 Univ., 75 (France); Institut Francais du Petrole (IFP), 92

- Rueil-Malmaison (France). Mar 1990. 229p. (In French). Order Number DE91753106. Source: OSTI; NTIS (US Sales Only).

Asphaltenes from Safaniya crude oil vacuum residues are studied by X-ray and neutron central scattering and X-ray diffraction. A systematic study of these particles in solution in organic solvents is carried out. X-ray and neutron small angle scattering techniques are compared with 1 wt% solutions in o-xylene. Influence of solution aging, solvent and concentration are examined. Asphaltenes are plane particles 6 to 10 Angstroems thick and 80 to 180 A in diameter depending upon concentration and dispersing solvent. Internal structure is aggregated. Aging and concentration increase aggregation. Organisation of these systems is the same in distillation residues. Thickness is more important and periodic arrangements are observed as in solid asphaltenes. The particle size is decreased by temperature increase.

0250 Combustion

Refer also to citation(s) 12346, 13023, 13199

12417 (UCRL-JC–105417) **Simulation of chemical kinetics in combustion.** Westbrook, C.K.; Pitz, W.J. Lawrence Livermore National Lab., CA (USA). [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9009347–1: Conference on mechanism of non-uniform combustion, Tokyo (Japan), 10-11 Sep 1990). Order Number DE91008446. Source: OSTI; NTIS; GPO Dep.

Current modeling capabilities in the area of hydrocarbon fuel combustion are reviewed. The types of fuels which can be studied, the experimental conditions which can be examined, and the classes of practical problems which can be addressed will be outlined in this paper. We will use the technical problem of automotive engine knock as a case study, to illustrate the capabilities of current kinetic models. 15 refs., 4 figs., 2 tabs.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 12396, 12398

0305 Health and Safety

12418 (CONF-9005317–1) **Acoustics as applied to leak detection and pipe location.** Huebler, J.E.; Campbell, B.K. Institute of Gas Technology, Chicago, IL (USA). [1990]. 10p. Sponsored by Ins. From Gas Research Institute (GRI) workshop on plastic pipe location; Chicago, IL (USA); 1-2 May 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

This paper gives a brief overview of the application of acoustics to the gas industry problems of leak and pipe location. Active and passive sonic leak location are briefly described. Two approaches to acoustic pipe location, "acoustic radar" or pulse echo and active sonic pipe location, are discussed. The active sonic technique is very promising for plastic pipe location. 18 refs.

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 12405, 12408, 12409, 12410, 12900

12419 (CONF-8911282–1) **The use of microcomputers for natural gas planning and demand management.** Blazek, C.F.; Biederman, R.T. Institute of Gas Technology, Chicago, IL (USA). [1989]. 18p. Sponsored by Ins. From ASCOPE '89: 4th ASEAN council on petroleum; Singapore (Singapore); 14-16 Nov 1989. Source: OSTI; Institute of Gas Technology, 3424 South State St., Chicago, IL 60616.

The Institute of Gas Technology has developed a natural gas planning and demand management model (GAS MAP) which provides a consistent means for assessing various gas supply/demand strategies. This computerized analytical model has been used to determine the economic costs and benefits of alternative policies for developing and utilizing Pakistan's natural gas resources. However, IGT feels that the analytical approach used in GAS MAP would be well suited to India or any other country experiencing a developing natural gas infrastructure. The overall model consists of a set of data bases and submodels. Interacting with the main program are five data bases; one each for investment/operating costs, supply analysis, demand analysis, alternative energy cost analysis, and economic and financial parameters. 2 figs.

12420 (CONF-9010322–1) **The potential for natural gas planning and demand management in India.** Blazek, C.F.; Biederman, R.T. Institute of Gas Technology, Chicago, IL (USA). [1990]. 18p. Sponsored by Ins. From Chem-Tech 90; New Delhi (India); 6-12 Oct 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology has developed a natural gas planning and demand management model (GAS MAP) which provides a consistent means for assessing various gas supply/demand strategies. This computerized analytical model has been used to determine the economic costs and benefits of alternative policies for developing and utilizing Pakistan's natural gas resources. However, IGT feels that the analytical approach used in GAS MAP would be well suited to India or any other country experiencing a developing natural gas infrastructure. The overall model consists of a set of data bases and submodels. Interacting with the main program are five data bases; one each for investment/operating costs, supply analysis, demand analysis, alternative energy cost analysis, and economic and financial parameters. 2 figs.

12421 (DOE/EIA–0130(91/02)) **Natural gas monthly, February 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. Feb 1991. 155p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008866. Source: OSTI; NTIS; GPO; GPO Dep.

The Natural Gas Monthly (NGM) highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information. The data in this publication are collected on surveys conducted by the EIA to fulfill its responsibilities for gathering and reporting energy data. Some of the data are collected under the authority of the Federal Energy Regulatory Commission (FERC), an independent commission within the DOE, which has jurisdiction primarily in the regulation of electric utilities and the interstate natural gas industry. Explanatory Notes supplement the information found in tables of the report. A description of the data collection surveys that support the NGM is provided in the Data Sources section. A glossary of the terms used in this report is also provided to assist readers in understanding the data presented in this publication. 10 figs., 40 tabs.

12422 (IFP–38-467) **Disequilibrium econometrics. An application to modelling of the natural gas market in the USA.** Barret, C. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France); Dijon Univ., 21 (France). Aug 1990. 414p. (In French). Order Number DE91757843. Source: OSTI; NTIS (US Sales Only).

Econometrics methods applicable to limited dependent variable models are presented. Qualitative models are briefly reported, TOBIT models and disequilibrium models are developed. The different formulations are used for simulating the gas market in the USA. Evolution and regulations of this market are reported and an approach by disequilibrium is developed.

0307 Waste Management

Refer also to citation(s) 12346, 13444

0320 Transport, Handling, and Storage

Refer also to citation(s) 13014

12423 (ETDE-mf–1759414) **Stress, deformation, and crack formation of reinforced concrete units at low temperatures.** Pusch, U. Technische Univ. Braunschweig (Germany, F.R.). Fachbereich fuer Bauingenieur- und Vermessungswesen. 14 Feb 1990 253p. (In German). Order Number DE91759414. Source: OSTI; NTIS (US Sales Only).

This thesis studies the stress deformations and cracking of reinforced and prestressed concrete units exposed to differ two different kinds of stress. The study looks at units under load stress in a homogeneous low-temperature field; this stress symbolises the LNG-filled inner container in operation. The stress load of components after a one-sided cold shock is also investigated. This load stands for the ideal hypothetic accident of a large rupture where the inner contains is ripped open like a zip releasing the contents as a whole, the outer container receives a severe cold shock over a large area. In calculating LNG-containers the planning engineer needs realistic rigidity values and correct concepts of crack width in order to judge linear integrity. (orig./HS).

0340 Combustion

Refer also to citation(s) 12317, 12325, 12346, 12347, 12651, 13004, 13023

12424 (CONF-9004280–1-Vugraphs) **Developments in ultra-low-emission natural gas combustion.** O'Sullivan, J.B.; Khinkis, M.J. Institute of Gas Technology, Chicago, IL (USA). [1990]. 50p. Sponsored by Ins. From Vancouver industrial gas '90 conference; Vancouver (UK); 18 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology (IGT) has pioneered in the development of a series of burner/combustor designs to yield ultra-low emissions in a variety of applications. Some of these developments are commercialized, and others are well on the way to commercialization and entry into the market through cooperative efforts with manufacturers. Others are in an earlier stage of development and a potential manufacturer has not yet joined our team. This presentation covers some of these developments so that those in the gas marketing and gas utilization sectors of the industry will be aware of the progress being made. IGT believes that natural gas, by its nature, permits the design and operation of ultra-low-emission combustion processes more readily than other fuels. Although other fuels may be used for emergency and backup, their use will come at the expense of increased emissions and/or reduced efficiency. Many of the IGT-designed units described here are founded on our use of cyclonic combustion to provide thorough and intensive mixing and recirculation, the careful application of air and/or fuel staging, and enhanced heat transfer to the load to moderate flame temperature.

04 OIL SHALES AND TAR SANDS

0402 Reserves, Geology, and Exploration

12425 (CONF-871198–) **1987 Eastern oil shale symposium: Proceedings.** Pettit, R. (ed.). Kentucky Energy Cabinet Lab., Lexington, KY (USA). Mar 1988. 364p. Sponsored by USDOE, Was. DOE Contract FG21-88MC11091. (KECL–87-175). From 1987 Eastern oil shale symposium; Lexington, KY (USA); 18-20 Nov 1987. Order Number DE91008071. Source: OSTI; NTIS; GPO Dep.

The theme of the 1987 Eastern Oil Shale Symposium was primarily based on research and development activities to obtain a sound oil shale data base for understanding the fundamental technology aspects relating to future process applications. Attendance remained about the same as in 1986 with 101 individuals registering for the meeting and 44 oil shale papers presented in three sessions. Contributors to the oil shale sessions were: two from industry, nine from government, 30 from universities and three from other sources. The tar sand session with seven papers continued to be a positive addition to the symposium. The uncertainty of the world oil situation and fluctuating crude prices leave the energy situation volatile. However, in any case, the strong foreign influence of US energy policy will be with us in the foreseeable future. Although the commercial scale oil shale demonstration plants are at best only holding on and no new ventures are being considered, research is ongoing. The federal government, with some state and industry support, are continuing to fund research. These efforts will provide an important data base for the eastern US oil shale industry in the future. Topics included environmental impacts, reclamation research, work in tar sands research, geology, geochemistry, processing, and technology. Individual papers have been cataloged separately. (SM)

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 12425, 12429

12426 (DOE/MC/11076–2951) **Development of an inclined liquid fluidized bed for tar sand processing.** Johnson, L.A. Jr. Western Research Inst., Laramie, WY (USA). Dec 1989. 15p. Sponsored by USDOE,. DOE Contract FC21-86MC11076. Order Number DE91002029. Source: OSTI; NTIS; GPO Dep.

An inclined liquid fluidized-bed reactor (ILFBR) system has been developed and successfully operated for 24 hours. Modifications to the previously tested ILFBR systems include incorporation of a oil fluidizing zone in the front of the fluid bed, an increase in the angle of the fluid bed to −12° (the minus sign shows that the discharges is below the horizontal level of the inlet), and reduction of the fluidizing gas velocities equal to or below the minimum fluidization velocity. These changes produced a functional bubbling slurry bed for the processing of tar sand. The produced oils and spent sand resemble the products from screw pyrolysis reactor (SPR) tests suggesting that the ILFBR system functioned similar to the SPR systems with the recycle oil pyrolysis and extraction (ROPE©) process. With slight modifications in the heater control and placement, the system will be ready for development of operational parameters for the surface processing of tar sand. 10 refs., 2 figs., 1 tab.

12427 (SIEMENS-KWU-E–331-90/002) **Hydropyrolysis of oil shale in the pressurized fluidized bed. Final report.** Brunner, G.; Dehrmann, T.; Kastner, W.; Kuenstle, K.; Lochner, H.; Rippel, R. Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1990. 124p. (In German). Contract BMFT 0326559A. Order Number DE91756651. Source: OSTI; NTIS (US Sales Only).

In view of the long term shortage of crude oil a process is tested in a laboratory plant for gaining oil from oil shales. The method is based on the hydropyrolysis of oil shale in a pressurized fluidized bed. By variation of the system pressure (5-13 MPa, H_2) and the pyrolysis temperature (380-550deg C) the characteristics of this process had been analysed. At the investigation of the main influencing parameters on oil yield of up to 167% of the Fischer-yield was obtained. The experimental results are used as basic data for the design of a commercial plant (10000 t/d). The hydropyrolysis process will be of economical interests at crude oil prices higher than 26 US Dollar/bbl. (orig.) With 10 refs., 15 tabs., 36 figs.

0405 Properties and Composition

Refer also to citation(s) 12430

12428 (DOE/MC/11076–2950) **Evaluation of the potential end use of oils produced by the ROPE© process from California tar sand.** Thomas, K.P.; Harnsberger, P.M. Western Research Inst., Laramie, WY (USA). Dec 1989. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC21-86MC11076. Order Number DE91002030. Source: OSTI; NTIS; GPO Dep.

The oil products produced by the rope process from Process Development Unit (PDU) run SPR-111 were evaluated for potential end use. This run was a five-day test using Arroyo Grande tar sand from California as the feed to the PDU. The distillate from knockout #2 was hydrotreated to produce a series of process intermediates. One of the intermediates was evaluated as a feedstock for the production of transportation fuels. The heavy product oil was distilled to produce a residue that was evaluated as an asphalt. Analysis of a selected process intermediate shows that it is not suitable for the

production of gasoline or for use as a gasoline-blending feedstock. The process intermediate was not suitable for the production of aviation turbine fuels because of a high concentration of alkanes. However, the presence of alkanes does make the oil valuable as a feedstock for the production of diesel fuel. The heavy oil product as received from the PDU is not suitable for the production of an asphaltic material because it contains a large amount of very fine solid material. However, after filtration and distillation, the application of ASTM D-3381 specification tests to the +410°C residue shows that all of the requirements are met except for the trichloroethylene solubility requirement. This value is below specification because a small amount of mineral matter was not removed during the filtrations process. Also, the residue had a very high aging index. Results from successive freeze-thaw cycling also show that the residue is comparable to petroleum asphalts when it is coated on the same appropriate aggregate. 14 refs., 8 figs., 8 tabs.

12429 (UCRL-ID–106505) **Pyromat II micropyrolysis of source rocks and oil shales: Effects of native content and sample size on T_{max} values and kinetic parameters.** Reynolds, J.G.; Murray, A. Lawrence Livermore National Lab., CA (USA). Jan 1991. 28p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91007996. Source: OSTI; NTIS; GPO Dep.

The Pyromat 2 micropyrolyzer can routinely measure kinetics on standard shales and source rocks. However, when examining samples which have high native bitumen contents, samples with high TOC and native bitumen contents, asphaltenes, tar sands, and other non-kerogen type materials, the pyrolysis profiles sometimes deviate from normal expected behavior. Some of the deviant features are: (1) evolution before the maximum assigned to kerogen breakdown, (2) broadening of the maximum assigned to kerogen breakdown and shifting in T_{max} with increasing sample size, and (3) artifacts in activation energy distributions derived in kinetic analyses. This report examines these features in more detail and offers potential experimental solutions to circumvent problems created by these features. 9 refs., 9 figs., 5 tabs.

0406 Products and By-Products

Refer also to citation(s) 12428, 12430

0408 Economic, Industrial, and Business Aspects

12430 (DOE/MC/11076–2949) **Potential small-scale development of western oil shale.** Smith, V.; Renk, R.; Nordin, J.; Chatwin, T.; Harnsberger, M.; Fahy, L.J.; Cha, C.Y.; Smith, E.; Robertson, R. Western Research Inst., Laramie, WY (USA). Oct 1989. 66p. Sponsored by USDOE,. DOE Contract FC21-86MC11076. Order Number DE91002031. Source: OSTI; NTIS; GPO Dep.

Several studies have been undertaken in an effort to determine ways to enhance development of western oil shale under current market conditions for energy resources. This study includes a review of the commercial potential of western oil shale products and byproducts, a review of retorting processes, an economic evaluation of a small-scale commercial operation, and a description of the environmental requirements of such an operation. Shale oil used as a blend in conventional asphalt appears to have the most potential for entering today's market. Based on present prices for conventional petroleum, other products from oil shale do not appear competitive at this time or will require considerable marketing to establish a position in the marketplace. Other uses for oil shale and spent shale, such as for sulfur sorbtion, power generation, cement, aggregate, and soil stabilization, are limited economically by transportation costs. The three-state area area consisting of Colorado, Utah, and Wyoming seems reasonable for the entry of shale oil-blended asphalt into the commercial market. From a review of retorting technologies and the product characteristics from various retorting processes it was determined that the direct heating Paraho and inclined fluidized-bed processes produce a high proportion of heavy material with a high nitrogen content. The two processes are complementary in that they are each best suited to processing different size ranges of materials. An economic evaluation of a 2000-b/d shale oil facility shows that the operation is potentially viable, if the price obtained for the shale oil residue is in the top range of prices projected for this product. Environmental requirements for building and operating an oil shale processing facility are concerned with permitting, control of emissions and discharges, and monitoring. 62 refs., 6 figs., 10 tabs.

0409 Waste Management

Refer also to citation(s) 12430

0410 Environmental Aspects

Refer also to citation(s) 12425

12431 (ORNL/TM–11467) **Geology and hydrology of the shallow alluvial aquifer, West Sharrard Gulch, Colorado.** Smuin, D.R. Oak Ridge National Lab., TN (USA). Mar 1991. 53p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009046. Source: OSTI; NTIS; GPO Dep.

Interactions between the alluvial groundwater and the surface water in West Sharrard Creek were studied during a series of investigations prompted by concerns over former waste disposal sites along the drainage. West Sharrard Gulch is adjacent to the former site of the Anvil Points Facility. The investigations involved well installations, groundwater monitoring and surface water studies. The studies revealed that surface water and groundwater along West Sharrard Gulch are linked by a series of recharge and discharge zones. These zones are in turn directly related to the gradients controlled by the differential erosion of various bedrock layers. Groundwater seeps were found at predictable locations based on the intersection of alluvial groundwater at streambed nickpoints. The nickpoints result when streambed erosion exposes sandstone lenses in the underlying Wasatch Formation. Information from well logs, groundwater monitoring records, and topographic maps was combined to form a conceptual model of the flow relationships. Similar models may have application for siting future waste disposal facilities related to oil shale development in the Piceance Creek Basin. 20 refs., 8 figs., 1 tab.

05 NUCLEAR FUELS

Refer also to citation(s) 12655, 13057

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 12444, 13473, 13474, 13476

12432 (INIS-mf–12779, pp. 93-101) **Uranium distribution in mineral phases or rocks by a five phase sequential extraction procedure.** Yanase, N. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Jan 1990. 146p. In *Alligator Rivers analogue project: First annual report 1988-1989.* Order Number DE91618691. Source: OSTI; NTIS (US Sales Only); INIS.

Sequential extraction techniques are used to measure the fractionation of uranium and thorium series nuclides in iron/clay/quartz phases etc. as part of the uranium/thorium desequilibria database preparation and understand how the two (or more) separated phases are related to the ore minerals and their accessibility to groundwater. Samples have been characterized for elemental associations and mineralogical distributions. Special attention was given to those elements which have particular significance for the geochemical modelling including species such as phosphate. In the secondary ore body, crystalline iron minerals such as limonite and pyrite appear as the significant mineral phase associated with uranium accumulation. The Morgan's and Tamm's solution extractable minerals (adsorbed and carbonate, and amorphous iron minerals respectively) are accessible to groundwater and so their $^{234}U/^{238}U$ activity ratios, less than unity, are equal to that of the groundwater. The remaining resistant minerals (mainly quartz) are the significant mineral phase found to be enrich with ^{234}U by the alpha recoil effect. However, in the shallow region of the primary ore body, the

Tamm's solution extractable minerals (secondary uranium minerals such as autunite and torbernite - uranyl phosphates) are the significant mineral phase associated with the uranium accumulation. In the deeper region of the primary ore body, the 6 M HCl extractable minerals (clay and some refactory minerals) seems to be predominant. 5 refs., 1 tab., 3 figs.

12433 (INIS-mf–12779, pp. 103-111) **Migration behavior of uranium series nuclides in altered quartz-chlorite schist.** Sekine, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ohnuki, T.; Murakami, T.; Isobe, H. Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Jan 1990. 146p. In *Alligator Rivers analogue project: First annual report 1988-1989.* Order Number DE91618691. Source: OSTI; NTIS (US Sales Only); INIS.

The study of alteration and the migration behavior of uranium series nuclides has led to the following conclusions: The distributions of the $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ activity ratios in the surface, intermediate and deep layers, indicate that the migration behavior of the uranium series nuclides differs between depths. The relationship between the $^{234}U/^{238}U$ and $^{230}Th/^{238}U$ activity ratios along the surface, intermediate and deep layers reveals that the mobility of the nuclides is in the order of ^{238}U, ^{234}U, and ^{230}Th and that the retardation factors of ^{234}U are greater than those of ^{238}U by a factor of 1.1, 1.9, and 1 in the surface, intermediate, and deep layers, respectively. The difference in the migration behavior of the nuclides between depths may be related to the different mineral assemblages identified by X-ray diffraction analysis. 12 refs., 4 figs.

12434 (INIS-mf–12784, pp. 121-128) **Ground magnetic exploration for radioactive minerals in Missikat area eastern desert of Egypt.** Sadek, H.S. (Nuclear Materials Corporation, Cairo (Egypt)); Soliman, S.A.; Abdelhady, H.M.; Elsayed, H.I. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

The airborne radiometric surveys and subsequent geological investigations proved the occurrence of uranium mineralization in jasperoid vein which cuts across the pink granites of Gebel El Missikat. The Missikat granites are intruded in older granodiorite and diorite exposures where the whole system is intersected by a system of faults and sheers. The relationship between the different structures and the origin of mineralization is not yet understood. The present study is the first step in a systematic approach of subsurface geophysical exploration for the mineral deposits. Ground magnetic survey was conducted along more than 25 lines across the jasperoid vein and separated at 50m while the magnetic measurements were taken at stations spaced 20m apart. The collected data has been reduced and analysed automatically using appropriate advanced software. The interpretation of the resultant magnetic contour map and profiles reveals the subsurface configuration of the different lithologic units in the area. Most of the granodiorites, exposed due west, are just roof pendants where they are underlain by the Missikat granite pluton. In addition it was possible to map the subsurface contacts between the granites and other geologic units beneath the Wadi Alluvium. The structural interpretation of magnetic data succeeded to distinguish additional fault lines and shear zones in the area. In this respect, a system of NE shears parallel to the mineralized vein, was distinguished by the associated weak magnetic anomalies. The anomalies resulting from the vein and shears suggest wider repetition of the mineralization and in addition, they can be used to distinguish the locations of increasing mineral potential in depth. Such locations are recommended for further geophysical exploration using more effective, however, expensive methods such as induced polarization (IP), self potential (SP) and miseala mass. (Abstract Truncated)

12435 (INIS-mf–12784, pp. 134-141) **Distribution and intensity of radioactive anomalies in Wadi Dara area, north-eastern desert, Egypt.** Salman, A.B. (Nuclear Materials Corporation, Cairo (Egypt)); Shalaby, M.H.; El Kassas, I.A. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Field radiometric survey of Wadi Dara area in the north-eastern desert of Egypt, led to discovery of 31 radioactive anomalies connected to different rock types of the basement complex namely; pegmatite, alpite, felsite and bostonite, beside some placer deposits in Wadi Alluvium. In the present work, these radioactive anomalies are statistically classified according to their distribution and their radioactive intensities with respect to the type and radioactivity of their host rocks and the surrounding country rocks.

12436 (INIS-mf–12784, pp. 149-155) **Contribution to the radioactivity of Um Ara granitic pluton, south-eastern desert, Egypt.** El Reedy, M.W. (Nuclear Materials Corporation, Cairo (Egypt)); Kamel, A.F.; Mansour, S.E.I. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Um Ara area lies in the southern part of the eastern desert between latitudes $22^0 30'$ and $22^0 41'N$ and longitudes $33^0 46'$ and $33^0 54'E$. Several types of granitic varieties ranging from high silica granite (SiO_2 >75%) to low silica granite (SiO_2 68-70%) occur in Um Ara granitic pluton. Surface samples were collected from the high anomalous locations in the pluton together with trenches samples (about 50cm in depth). The U content in the surface samples ranges from 69 to 7 ppm while in trenches samples, it ranges from 38 to 759 ppm. The thorium content on the other hand ranges from 34 to 402 ppm in surface samples and from 158 to 316 ppm in trenches samples. Some samples show no Th contents. The Th/U ratios ranges from 0.065 to 3.137 in surface samples and from 0.386 to 2.590 in trenches samples. An enrichment of U content is the main feature characterising this granitic pluton, it is mainly connected with the fractured zones. Uranium is mostly present as secondary U mineralization accompanied by Fe, Mn and to some extent by carbonate materials. A hydrothermal origin could be considered for this U mineralization in the pluton. Primary U mineralization (pitchblende) together with secondary mineralization was observed in some locations in the area disseminated in the granite, this reflects the syngenetic origin of this granitic type.

12437 (INIS-mf–12784, pp. 156-163) **Distribution of radioactivity in Um Dwella Dyke, south-eastern desert, Egypt.** Hussein, H.A. (Nuclear Materials Corporation, Cairo (Egypt)); Mansour, S.I.; Kamel, A.F.; El-Reedy, M.W. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Um Dwella area is characterized by the presence of an elongate dike extending about 10.5 km in a NE-SW direction. This dike is intruding metavolcanics and metasediments. Detailed field geologic and radiometric study was carried out in the whole area for the dike and the country rocks. It was found that the dike is composed of alkaline to subalkaline rocks. The country rocks are mainly metavolcanics and metasediments with small exposure of diorites. The main trends of dikes, faults and joints are represented in rose diagrams. Radioactivity measurements in the field showed that Dwella dike has promising potential because there are anomalous zones where the rocks are highly fractured and show alteration products. Moreover, the parts of the dike intruding metasediments show relative increase of radioactivity than those intruding metavolcanics. Two groups of samples were collected all over the dike. The first group was selected from the northern part of the dike while the second group represents samples chosen from the Central to Southern parts. The preliminary U and Th data show a significant variation in the two groups. In the first, U content ranges from 347 to 1600 ppm while Th content ranges from 1135 to 2817

ppm. The second group of samples have U content ranging from 229 to 1380, and Th content ranging from 8 to 97 ppm. The calculated Th/U ratios of the first group vary from 1.49 to 5.63 while in the second group from 0.010 to 0.120. In view of the obtained data, two phases of radioactive mineralization could be considered to occur in this area. A discussion has been given to explain our assumption.

12438 (INIS-mf–12784, pp. 164-170) **Radioactivity and concentration of radioactive minerals of the granitic pluton of Abu-Garadi area, eastern desert, Egypt.** El Reedy, M.W.; Abdel Monem, H.M. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Six bulk representative granitic samples were collected from trenches at Abu-Garadi granitic pluton, central eastern desert. The U content ranges from 7 to 57 ppm while Th content ranges from 23 to 121 ppm. The calculated Th/U ratios are in the ranges of 2.0 to 3.3. Mineralogical investigation proved that zircon and uranothorite are main radioactive minerals which are responsible for the radioactivity of the granite. For separating such radioactive minerals, gravity and magnetic separation techniques have been used. Gravity separation could render it possible to collect all the radioactive minerals in one bulk concentrate; whereas, the high intensity magnetic separation proved to have rather good potentialities in separating uranothorite and zircon mineral grains from tabling concentrate. According to the proposed flowsheet, more than 90% those radioactive minerals could be recovered in two concentrates, namely, uranothorite (assimilated 0.14% U and 0.42% Th) and zircon (assimilated 0.06% U and 0.17% Th).

12439 (INIS-mf–12784, pp. 171-177) **The study of the radioactive dyke at Um Domi area, south-eastern desert, Egypt.** Kamel, A.F. (Nuclear Materials Corporation, Cairo (Egypt)); Mansour, S.I.; Abu Zeid, H.T. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Um Domi area is covered by metasediments intruded by a trachytic dike which is composed of hard, compact, fine grained rocks. The area is dissected by three dominant sets of fractures trending NW-SE, NNW-SSE and WNW-ESE. The present work deals with the geology, structure and radioactivity of Um Domi area. Comparison between the radiometric map and structural contour map of the same scale showed that there is similarity between the two maps indicating that radioactivity is structurally controlled by fractures trending N30W to N40W. The field examination of the granitic rocks, indicating that there is no visible uranium mineralization and high level of radioactivity may be attributed to thorium rather than uranium minerals.

12440 (INIS-mf–12784, pp. 193-200) **Uranium potentialities in the Egyptian phosphate.** Hussein, H.A. (Nuclear Materials Corporation, Cairo (Egypt)); Guirguis, L.A.; El Reedy, M.W. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

The phosphate deposits of Egypt are of Upper Cretaceous age and are known to occur in three main provinces: The Red Sea Coast, Nile valley and Abu Tartour plateau near El Kharga Oasis, western desert. During the last several years 600,000 tons of phosphate rock were produced annually. Half of this amount are commercially processed for fertilizer and phosphate chemicals while the rest are exported. Confirmed reserves are estimated to be 30 million tons, 75 million tons and 700 million tons at the Red Sea Region, Nile valley, and Abu Tartour plateau respectively. This can show the importance of the phosphate rocks as a potential source of uranium. Uranium analyses previously reported and presented obtained for about 3000 samples in the different studied areas. In general it is within the range of 12 to 185g uranium/ton ore. Uranium seldom if ever forms its own minerals within the rock but it is caught up in the framework of the phosphate minerals. In fact the uranium is found to be completely in the tetravalent state at Abu Tartour phosphorites. On the other hand the estimated tetravalent uranium is 70 and 80% for the Nile Valley and The Red Sea Coast phosphates respectively. Moreover, post depositional enrichment of uranium in the Red Sea phosphate was less than that of the Nile Valley and greater than that of Abu Tartour phosphate. The uranium potentialities in the Egyptian phosphates could be estimated as 80,000 tons uranium.

12441 (INIS-mf–12784, pp. 216-223) **Establishment of statistical background radioactivity levels of rocks and soils in Cairo Bahariya Area, north-western desert, Egypt.** Kadry M, Fouad (Nuclear Materials Authority, Cairo (Egypt)); Abu El Hoda M, El Sirafy. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

The study area lies in the eastern portion of the north-western desert of Egypt. Its surface area approximates 55000 square kilometers mainly covered by Tertiary rocks and sediments with few local cretaceous outcrops and some sporadically exposed volcanic rocks (basalts) which are believed to be of Late Oligocene-Early Miocene age. The area has been aeroradiometrically surveyed as a part of the uranium exploration program of the Nuclear Materials Corporation of Egypt. This included regional as well as detailed total count gamma-ray surveys. Aeroradiometric survey data have been statistically analysed to establish the nature of distribution of the radioactivity measurements within each of the individual surface geologic units. Some statistical inference tests were applied to examine the computed statistical parameters possessed by the different interpreted radiometric units and subunits. It was evident throughout this study that, there is a remarkably good correlation between the mean background radiation intensity and surficial rock types and sediments. In general the studied area shows relatively low levels of aeroradioactivity. However, statistical analysis of aeroradiometric data resulted in the definition of two radiometric units with a distinct relatively high level of gamma-radiation. The first unit was found to be associated with some pliocene outcrops of fossiliferous sandstones. The second units are associated with the Upper Eocene rocks outcropping in Datrani area north of El-Fayum province, these are mainly composed of alternating series of highly fossiliferous shales and sandstones with few band of limestones. The shales are in some instances highly lignitic. Further investigations of these upper Eocene rocks indicate that they are preferentially enriched in radioactive minerals and therefore can be considered as a prospect area for exploration of radioactive mineral deposits.

12442 (INIS-mf–12784, pp. 269-277) **Geological and beneficiation studies on euxenite bearing pegmatite rock of Gebel Dara, north-eastern desert Egypt.** Abdel Monem, H.M. (Nuclear Materials Corporation, Cairo (Egypt)); Shalaby, M.H.; Salman, A.B. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Gebel Dara is included within the northern parts of the Red Sea Hills. It is essentially composed of younger pink granite of about 600 m.y. age. The marginal parts of G. Dara are characterized by the presence of numerous pegmatite bodies mainly of the unzoned type. Several radioactive anomalies were recorded in these pegmatites that ranges from 500 to 10,000 cps. Radiometric metallographic studies indicate that the high radioactivity of some of these pegmatite bodies is due to euxenite. The eU, eTh and F contents are 0.068%, 0.005% and 3.31% respectively. Gravity separation applied on -85 mesh screen materials using wet tabling

achieved a trial to concentrate and separate euxenite from the associated fluorite and feldspars mineral grains. Flotation of tabling tails, using oleic acid as collector in relation to pH of the pulp, sodium silicate as depressent and cresylic acid as further exhibit a good hydrophobic property on the surfaces of fluorite mineral grains. According to the proposed flowsheet, more than 89% of euxenite and 68% of fluorite could be recovered in two concentrates respectively.

12443 (INIS-mf–12784, pp. 278-285) **Geology and pyrotreatment studies on dolomite bearing uraniferous phosphate from Hamrawein area, eastern desert, Egypt.** Abdel Monem, H.M. (Nuclear Materials Corporation, Cairo (Egypt)); Mansour, S.E.I.; Kamel, A.F. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Low grade uraniferous phosphate rock assaying 20.85% P_2O_5 and 0.027% U_3O_8 from Hamrawein area contains predominantly dolostone gangue. The investigated rock samples where composed mainly of collophane and less commonly carbonate-fluorapatite set in fine to medium grained matrix of dolomite, calcite and clay materials. The main factors of calcination process have been developed with the object of enriching P_2O_5 and U_3O_8 in the calcined materials. Calcination at 875 + 25°C for about 50 minutes are optimized for decomposing carbonates. The calcined materials should be quenched in sea water at pH 2.0 (using H_3PO_4) at a temperature not lower than 450°C, otherwise recarbonation takes place. By attritioning and desliming of the calcined materials, a higher phosphate concentrate is achieved. According to the proposed flowsheet, a high grade concentrate assaying more than 33% P_2O_5 and 0.06 U_3O_8 with a recovery of 75% is attained.

0504 Feed Processing

Refer also to citation(s) 12443

12444 (INIS-mf–12784, pp. 286-292) **Thermal reduction and U-recovery from uraniferous phosphorite concentrate of phosphatic sandstone deposit of G. Qatrani, western desert, Egypt.** Abdel Monem, H.M. (Nuclear Materials Corporation, Cairo (Egypt)). Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

The produced uraniferous phosphorite concentrate from cationic floatation of phosphatic sandstone of G. Qatrani contain 32.01% P_2O_5, 0.39% eU and 5.65% SiO_2. Thermal reduction technique using a high calorific hydrocarbon (Mazout) is used to recover U and P_2O_5. At elevated temperature ranging from 500 to 800°C, reducing gases mainly, Co are evolved due to mazout cracking; beside a carbon film is precipitated around the treated phosphate grains. These conditions have proved quite beneficial in reducing U+6 into U+4, as well as creating a sufficiently low redox potential below 350 mV in the subsequent leach solution. The effect of different relevant factors are studied and optimized as 700 C, 30 minutes and 20% (wt/wt) ratio for reducing temperature, duration time and amount of reductant added respectively. Hydrochloric acid of 8 N appears to offer the best potential for acidulation of the reduced phosphates at room temperature (25°C) and 30 minutes retention time of agitation leaching. The results showed that, more than 98% of P_2O_5 reports in solution as phosphoric acid and about 97% of uranium is retained in an insoluble form (U+4). Applying oxidizing roast of the leached reduced materials at 800°C in the presence of 2% NaCl, would result in both removing the carbon content and oxidizing the contained U+4 to U+6. By subsequent leaching with dilute acidic solution (2N HCl) more than 98% of the contained U+6 is readily soluble.

0505 Uranium Enrichment

Refer also to citation(s) 13325

0507 Fuels Production and Properties

Refer also to citation(s) 12696, 12761, 12821, 12822

12445 (HW–59408) **Chemical reactivity of uranium monocarbide and uranium mononitride with water at 100°C.** Newkirk, H.W. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 26 Feb 1959. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91008545. Source: OSTI; NTIS; GPO Dep.

The monocarbide and the mononitride of uranium are potentially useful ceramic nuclear fuel materials. This paper reports the results of exploratory investigations of the reactions of uranium monocarbide and uranium mononitride with boiling water. Uranium dioxide, chemically stable in deoxygenated boiling water, was used as a control. The experimental results are assembled and illustrate the surface morphology of the particles before and after heating in boiling water. The amount of material not recovered is considered to be less than the experimental error of the technique. In particular, the uranium monocarbide formed a greyish-green slime on the sides of the flask, which made total recovery difficult. The x-ray and electron microscopy results show that uranium mononcarbide reacted with water to form uranium dioxide. Uranium dioxide was insoluble under the experimental conditions. Uranium monoitride remained unaffected by the boiling distilled water. Uranium monocarbide powder reacts with boiling, distilled water to form uranium dioxide. Uranium monoitride is unaffected by heating in boiling, distilled water for 24 hours. 3 figs., 1 tab.

12446 (Y/DZ–709) **Removal of liquids from uranium chips.** Childs, Y.C.; Napier, J.M. Oak Ridge Y-12 Plant, TN (USA). 13 Mar 1991. 65p. Sponsored by USDOE,. DOE Contract AC05-84OS21400. Order Number DE91009195. Source: OSTI; NTIS; GPO Dep.

A method of removing most of the liquid entrained in uranium and uranium alloy chips processed at the Uranium Chip Oxidation Facility (UCOF) was needed to reduce the frequency of flameouts. Several different methods of reducing the liquid entrained in the chips were tried. The best method identified was spin drying the chips in the chip spin drier, similar in design to a washing machine. This process reduced the amount of entrained liquid in the chips to 6 weight percent or less without drain holes in the drum and to less than 3 weight percent with drain holes. This paper details the various experiments that was performed and recommends that field testing of this equipment be done at the UCOF.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 12459, 12467, 12504, 12507, 12565, 12780, 12784, 12785, 12822, 12848, 13140, 13159

12447 (ANL/CP–71262) **TUCS: A new class of aqueous complexing agents for use in solvent extraction processes.** Horwitz, E.P.; Diamond, H.; Gatrone, R.C.; Nash, K.L.; Rickert, P.G. Argonne National Lab., IL (USA). [1990]. 6p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-9007123–2: ISEC'90: International Solvent Extraction Conference, Kyoto (Japan), 16-21 Jul 1990). Order Number DE91006812. Source: OSTI; NTIS; INIS; GPO Dep.

The 1-hydroxyethyl-1,1-diphosphonic (HEDPA) and vinylidene-1,1-disphosphonic (VDPA) acids have been studied as stripping agents for Am, Pu, and U from TRUEX process solvent (0.2 M CMPO-1.2 M TBP-dodecane). Both disphosphonic acids have been shown to be highly effective stripping agents using pristine process solvent as well as radiolytically degraded solvent. The actinide-HEDPA and -VDPA complexes are more soluble than the corresponding oxalate complexes and are readily destroyed by metal-catalyzed H_2O_2. 12 refs., 4 figs., 2 tabs.

12448 (CEA-CONF–9984) **^{31}P NMR spectroscopy as an analytical and an analytical tool in the purex process.** Vitart, X.; Musikas, C.; Livet, J.; Morisseau, J.C.; Vilarem, J.F. CEA Centre

d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1989. 11p. (CONF-890617--: 2. Karlsruhe international conference on analytical chemistry in nuclear technology, Karlsruhe (Germany, F.R.), 5-9 Jun 1989). Order Number DE91752707. Source: OSTI; NTIS (US Sales Only).

NMR of ^{31}P, is a very useful tool for analytical and structural investigations, especially when dealing with TBP and its phosphorous degradation products in the processing of irradiated fuel. NMR spectroscopy allows to separate and to quantify TBP, HDBP H_2MBP, H_3PO_4. The chemical shifts depend of protonations and nitric acid fixations because of fast chemical exchange. Conditions have to be optimised in order to discriminate the different compounds. The limit of sensitivity of the method is roughly 5 10^{-5} M/l with a 5mm probe.

12449 (CEA-CONF--10432) **Some plutonium IV polymers properties in purex process.** Scoazec, H.; Pasquiou, J.Y.; Germain, M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1990. 13p. (CONF-9009364--: Extraction'90 Meeting, Dounreay (UK), 10-14 Sep 1990). Order Number DE91757111. Source: OSTI; NTIS (US Sales Only).

Behaviour of plutonium polymers in fuel reprocessing using Purex process with TBP as solvent, and its practical consequence in real operation conditions are examined. Precipitation with dibutylphosphoric acid, a solvent degradation product, occurs both in extraction and stripping units when polymers are present. 12 refs.

12450 (CEA-CONF--10434) **Compounds of plutonium (IV) with alkylphosphates and phosphate in nuclear reprocessing.** Scoazec, H.; Livet, J.; Pasquiou, J.Y.; Germain, M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1990. 13p. (CONF-9009364--: Extraction'90 Meeting, Dounreay (UK), 10-14 Sep 1990). Order Number DE91757113. Source: OSTI; NTIS (US Sales Only).

The nature of Pu (IV)-alkylphosphates and phosphate formed, especially in the PUREX process chemical conditions, has been studied. (i) With HDBP, two solid compounds: $Pu(DBP)_3NO_3,xH_2O$ and $Pu(DBP)_4$ have been identified in aqueous phase, and only one $Pu(DBP)_3NO_3$ in organic phase, (ii) With H_2MBP one compound was found in aqueous phase: $Pu(MBP)_2,yH_2O$, while three compounds are formed with H_3PO_4, proposed formulas are $PU(HPO_4)(NO_3)_2$, $Pu(HPO_4)_2$ and $Pu_2H(PO_4)_3$. Solubility of some of these compounds were examined in the fuel reprocessing conditions, in aqueous or organic phase (30% TBP-diluent) excluding mixed biphasic systems. 9 refs.

12451 (FRCEA-TH--314) **Conception and development of a computer-aided design for a spent fuel reprocessing plant.** Blayrac, M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France); Lyon-1 Univ., 69 (France). Jun 1989. 222p. (In French). Order Number DE91752725. Source: OSTI; NTIS (US Sales Only).

A spent fuel reprocessing plant is composed of connected equipments. The aim of this study is the creation of schemes representing the different workshops of the plant and the calculation of linkage characteristics (flux) from a graphic description of functional structures. The program, written in FORTRAN 77, based on mass, flow rate and energy conservation, uses a module library each corresponding to an elementary operation of chemical engineering. Verification is necessary for result quality and accuracy. The important number of parameters and variables used in the program, requires a diagnosis accelerating research of errors for correction. Knowledges used in these last operations are qualitative (knowledge of experts) and quantitative (results of calculations) for the development of an expert system written in D-PROLOG.

12452 (FRCEA-TH--314-Ann) **Conception and development of a computer aided design for a spent fuel reprocessing plant. Appendixes.** Blayrac, M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France); Lyon-1 Univ., 69 (France). Jun 1989. 163p. (In French). Order Number DE91752724. Source: OSTI; NTIS (US Sales Only).

Appendixes of the main report are gathered in this volume and an example of use is given.

12453 (GSF--34/90) **Report of an environmental radioactivity measurement campaign in the Schwandorf region, 1989.** GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany, F.R.). Abt. fuer Technischen Strahlenschutz; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.). May 1990. 88p. (In German). Order Number DE91759429. Source: OSTI; NTIS (US Sales Only): INIS.

The measured results in some cases still reflect the effects of the Chernobyl reactor accident. Although the activity concentrations of Cs-134 and Cs-137 have diminished in almost all food samples, they still are higher than before Chernobyl. The level of activity concentration varies in the different types of food and exhibits significant fluctuations depending on site of measurement and time. The high activity levels measured in milk in autumn 1986, going up to 26 and 58 Bq/l, respectively, the data measured in the Schwandorf region in spring 1987 were considerably lower again, and in 1988 and 1989 remained on this lower level, ranging from 0.4 to 11 Bq/l. Local gamma activity measurements at 80 different measuring points in the period 1986 until 1988 show the following mean values: 1.09 mSv/a in 1986, 1.13 mSv/a in 1987, 1.03 mSv/a in 1988 and 1.11 mSv/a in 1989. Judging from the data measured in the early 1960s, which reflect the overground nuclear weapons tests, it can be expected that Cs-134 and Cs-137 from the Chernobyl fallout will contains to contribute most to radioactivity levels in the environmental samples. (orig./HP).

12454 (IAEA-TECDOC--580, pp. 77-84) **Spent fuel management in France: Programme status.** Chaudat, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243--: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

France's programme is best characterized as a closed fuel cycle including reprocessing, Plutonium recycling in PWR and use of breeder reactors. The current installed nuclear capacity is 52.5 GWe from 55 units. The spent fuel management scheme chosen is reprocessing. This paper describes the national programme, spent nuclear fuel storage, reprocessing and contracts for reprocessing of spent fuel from various countries. (author). 5 figs, 2 tabs.

12455 (WINCO--1081) **Two-part-liquid-mixture percentage measurement using a flow-through capacitance sensor.** Piper, T.C. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Jan 1991. 13p. Sponsored by USDOE,. DOE Contract AC07-84ID12435. Order Number DE91007584. Source: OSTI; NTIS; INIS; GPO Dep.

A flow-through capacitance sensor with application-specific electronics that includes auto-calibration and fail-safe circuitry has been built and tested to measure the percentage of tributyl phosphate (TBP) in n-dodecane. The system has been tested with the flow-through sensor at 100 foot distance from the electronics and shows no sensitivity to cable movement. The calibration data fits a second degree polynomial well. 6 figs., 1 tab.

0509 Transport, Handling, and Storage

Refer also to citation(s) 12454, 12467, 12503, 12504, 12505, 12506, 12507, 12781, 13193, 13216, 13220

12456 (DOE/WIPP--91-014) **Packaging Technical Review Board (PTRB) charter for the Waste Isolation Pilot Plant.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. Feb 1991. 3p. Sponsored by USDOE,. DOE Contract AC04-86AL31950. Order Number DE91008622. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. ALPHA-BEARING WASTES/packaging; WIPP; PACKAGING; WASTE TRANSPORTATION; CONTAINERS; PACKAGING RULES

12457 (EUR–12768) **Review, analysis and report on the radiological consequences resulting from accidents and incidents involving radioactive materials during transport in the period 1975-1986 by and within member states of the european communities.** Lombard, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR)); Ringot, C.; Tomachevsky, E.; Hughes, J.S.; Shaw, K.B. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 66p. Contracts: 88-B-7020-11-7-17;88-B-7020-11-8-17. Source: OSTI; NTIS (US Sales Only).

Radioactive materials are routinely transported throughout the European Communities, by all modes of transport. These shipments occur in accordance with comprehensive regulations and the vast majority of these shipments are made without incident. Occasionally however accidents and other incidents have occurred at various stages of transport operations and the purpose of this study was to examine the available information on events that occurred within the Communities during the years 1975 to 1986. The information was gathered from Member States' Competent Authorities and other organisations, using a questionnaire. Most of the detailed information came from the two countries carrying out the study, the UK and France. The information gathered covered many different types of event involving a wide range of materials: it is concluded that under-reporting is a major source of uncertainty in the results. Therefore, it is emphasised that care should be used in comparisons between the results for different types of transport operations, since accidents and incidents involving certain types of transport are more fully reported than others. Consequently, the authors stress the need for improved reporting and recording procedures. No evidence was found of any major health consequences resulting from the accidents and incidents studied. However, there were instances of high doses having been received by workers, mainly as a result of inadequate preparation of packages prior to despatch. These events point to the need to maintain high standards of quality assurance at all stages of transport operations.

12458 (IAEA-TECDOC–580, pp. 95-102) **Spent fuel management in India.** International Atomic Energy Agency, Vienna (Austria); Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div. Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

Indian nuclear energy programme envisages a 3 stage approach having PHWRs utilising the uranium reserves available in the country followed by plutonium recycling in FBRs and Th-U^{233} based fast reactors forming the third generation reactors. The spent fuel management scheme adopted is reprocessing. The two BWRs are in operation since the last two decades and the spent fuel generated is under continued storage. This paper describes the national programme of spent fuel management for the PHWRs, BWRs and two research reactors. (author).

12459 (IAEA-TECDOC–580, pp. 103-116) **Current status of spent fuel management in Japan.** Watanabe, I. (Science and Technology Agency, Tokyo (Japan). Atomic Energy Bureau); Maeda, M.; Sugiyama, T. International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

Japan now operates 37 nuclear power reactors with a combined capacity of 29 GWe. The future nuclear power generation capacity is forecasted to be at least 53 GWe in the year 2000. The basic policy of spent fuel management of Japan is to reprocess the spent fuel and to utilize the recovered U and Pu in thermal reactors as well as in FBR. The state of the art and plans for relevant R and D activities on spent fuel storage, reprocessing for thermal reactors and FBR, recycling of recovered U and Pu, and management of HLW are described. (author). 3 figs.

12460 (IAEA-TECDOC–580, pp. 117-124) **Spent fuel management in the Republic of Korea: Current status and prospects.** Park, W.J. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The continuous expansion and development of Nuclear Power Program in Korea have resulted in generation of the significant volume of the Nuclear Wastes. Among them, spent fuel generated from nuclear fuel cycle is one of the impending problems to be solved due to their inherent high radioactivity and long half life. Great efforts have been made to solve effectively these problems in spent fuel management which might be encountered within foreseeable future. In this presentation, the current status of spent fuel management in Korea are discussed, and the related R and D activities are briefly introduced. (author). 1 fig., 2 tabs.

12461 (IAEA-TECDOC–580, pp. 125-135) **Recent development of spent fuel management in the Central Storage Facility for Spent Fuel (CLAB) in Sweden.** Vogt, J. (Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Div. Systems and Facilities). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The Swedish nuclear waste management programme was presented at the Advisory Group Meeting held 15-18 March 1988. As there have been very small changes since then in the main strategy this paper is focusing the ongoing work to expand the capacity of the Central Storage Facility for Spent Fuel, CLAB, from 3.000 tonnes of uranium (tU) to 5.000 tU within the existing storage pools. This expansion makes it possible to postpone the investment in new storage pools in a second rock cavern by 6-8 years which gives a considerable economic advantage. Preliminary studies of several methods to realize the expansion led to a decision to use storage canisters similar to the existing ones. The new BWR canister will be designed to hold 25 fuel assemblies instead of 16 and the new PWR canister 9 assemblies instead of 5. The main problem is to maintain a sufficient margin against criticality with the new and denser fuel pattern. Two methods to achieve this have been more closely investigated: Credit for the burnup of the fuel; Neutron absorbing material in the canisters for reactivity control. A calculational work has been performed in order to analyze the margins which must be applied in the first case. One of the more important factors proved to be the margin required to cover the influence of axial profiles of burnup and Pu-build up for BWR fuel. Together with other necessary reactivity margins the total penalty which has to be applied amounted to about 12 reactivity percent units. With the requirement of a final K_{eff} value smaller than or equal to 0,95 this implied that a far to great proportion of the fuel arriving at CLAB would fall outside the acceptable region defined by initial enrichment and actual burnup. The method of taking full credit for fuel burnup therefore had to be abandoned in favour of the other method. (Abstract Truncated)

12462 (IAEA-TECDOC–580, pp. 137-140) **Spent fuel management in Switzerland.** Ospina, C. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

Switzerland currently has 3000 MWe being delivered from five nuclear power units. The current spent fuel management and waste disposal programme includes reprocessing of the spent fuel generated up to 1990. The plan for intermediate storage of spent fuel, high-level waste and low/medium level wastes is underway; the main features of the centralized storage facilities are given. (author). 1 fig.

12463 (IAEA-TECDOC–580, pp. 155-160) **Recent OECD/NEA activities in spent fuel management.** International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The OECD Nuclear Energy Agency (NEA) has been a participant in the IAEA's Regular Advisory Group Meetings on Spent Fuel Management: Current Status and Prospects. This report is intended to provide an update on NEA activities primarily from the perspective of the Nuclear Development and the Fuel Cycle Division. The NEA's recent assessment of the Use of Plutonium as a mixed oxide fuel is discussed. Current and planned studies in the areas of Qualified Manpower, the Economics of the Fuel Cycle, Cost Analysis of Decommissioning Nuclear Power Plants, and Repository Costs are also mentioned. Finally, a summary of selected NEA meetings and publications since 1986 which are applicable to spent fuel management is provided in the annexes. (author).

12464 (IAEA-TECDOC–580, pp. 149-154) **Spent nuclear fuel management in the United States of America.** International Atomic Energy Agency, Vienna (Austria); USDOE, Washington, DC (USA). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The inventory of spent nuclear fuel in storage in the United States exceeds 17,800 MTIHM and is increasing at a rate of approximately 1700 to 2100 MTIHM per year. No continuing commercial reprocessing has been employed in the United States, thus requiring the continued storage of the spent nuclear fuel. Essentially all of the spent fuel remains in storage in the spent fuel pools of the utilities that generated it. Where the initial spent fuel pool capacity was insufficient, the utilities have installed high density storage racks to maximize the pool capacity. Two utilities have begun to supplement their spent fuel pool storage through the use of dry storage, one in metal casks, and one in horizontal concrete modules. At least two more horizontal concrete module installations have been announced, and at least one utility is pursuing the use of concrete storage casks. The future plans for spent nuclear fuel management in the United States remain centered on utility storage of the spent fuel until it is accepted by the Department of Energy for geologic disposal. The Department has recently completed a bottoms-up reevaluation of the repository schedule, and is now projecting initial repository operation in the year 2010. As a result of the successful completion of dry storage demonstration activities conducted in cooperation with private utilities, the spent fuel management research and development program conducted by the Department of Energy has dwindled to a limited amount of research into generic storage topics and a small program associated with providing spent fuel storage and disposal assistance to non-nuclear weapons states. (Abstract Truncated)

12465 (PNL-SA–18999) **Radioactive waste shipments and tribal concerns.** Liebow, E. (Battelle Human Affairs Research Center, Seattle, WA (USA)); Holm, J.; McGinnis, K. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 14p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910270–19: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008746. Source: OSTI; NTIS; INIS; GPO Dep.

Several Indian tribes have registered concerns over the potential environmental, health, and safety and risks of transporting transuranic wastes to New Mexico's Waste Isolation Pilot Plant (WIPP) site. With the scheduled beginning of the WIPP test phase near at hand, the US Department of Energy (DOE) has sought to identify and accommodate tribal concerns. Appropriate DOE response to tribal concerns depends, in part, on understanding both the general nature of tribal interests and also the specific issues that individual tribes accord the greatest priority. Described here is the approach taken in the context of WIPP program activities to identify transportation-related tribal concerns, and to create an institutional arena for addressing these concerns by establishing cooperative agreements with two tribes whose jurisdictions are crossed by WIPP test-phase shipments. Special attention is directed to support for tribal activities involving public information, accident prevention, and emergency response; these activities are designed to enhance tribal capabilities for managing potential transportation-related impacts. 5 refs.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 12463, 12476, 12661

12466 (EUR–12675) **On society and nuclear energy: Final report.** Marchetti, C. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; International Inst. for Applied Systems Analysis, Laxenburg (Austria). 1990. 113p. Sponsored by Com. Contract PSS 0039/A. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 10.

The objective of this study is to use the hard methods of systems analysis to study the soft area of legislative activity, news coverage, reactor accidents and nuclear energy penetration. We have employed, for the first time in an analysis of press coverage and of reactor accidents, a model developed in the 1920s whose potential was fully developed during the last decade. According to this model the behavior of society is the consequence of cultural diffusion waves. Ideas, in the sense of cultural packets, are generated somehow and, if successfully selected, diffuse into the system and induce corresponding behavioral patterns. The model is quantitative, predictive, and mathematically very parsimonious. The basic constraint is that the diffusion process has a maximum potential, the niche. Competition, e.g., through innovation, brings a succession of occupants into the niche, whose dynamics are described by the model. Press coverage is studied extensively in the United States for two reasons. First, because there is a capillary monitoring of the US media, reliable data on time series are available. However, the same methodology can be applied to news coverage in Europe, and we have used it to analyze in detail the magazine Der Spiegel in relation to its coverage of nuclear energy. The second reason is that, due to the large number of reactors and not too sophisticated operator crews, the USA has a long list of reactor accidents from which significant signals can be extracted. The USA has also two very distinct waves of reactor construction, which makes the system more articulate and transparent. 45 refs., 45 figs., 3 tabs.

12467 (IAEA-TECDOC–580, pp. 141-148) **Changes in the UK nuclear generating industry and their impact on spent fuel management issues.** Hinton, R. (Nuclear Electric, London (UK). Nuclear Fuel Cycle and Sales Dept.). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The electricity industry, excluding the nuclear power stations, is being sold into private ownership. Nuclear generation is expected to compete alongside fossil generators. Electricity prices will be market led. This, together with contractual obligations under option contracts and future markets has lead to revised commercial trading between companies within the nuclear industry. There is no fundamental change in the UK policy on spent fuel management.

1320 tU of AGR fuel and all Magnox fuel arisings will continue to be reprocessed at Sellafield. All options, including dry and wet storage, direct disposal and reprocessing, are under consideration for the remaining AGRs' fuel and the fuel from the UK's single PWR. (author). 3 figs.

12468 (INIS-XN–307) **Uranium 1990 resources, production and demand: Statistical update.** Nuclear Energy Agency, 75 - Paris (France). 1990. 61p. (In English, French). Order Number DE91623469. Source: OSTI; NTIS (US Sales Only); INIS.

Periodic assessments of world uranium supply and demand have been conducted by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) since the mid 1960s. Published every two years, the report URANIUM RESOURCES, PRODUCTION AND DEMAND, commonly referred to as the RED BOOK, has become an essential reference document for nuclear planners and policy makers in the international nuclear community. The latest Red Book, published in 1990, was based on data collected mainly in early 1989. Most of the data for 1989 were therefore provisional. The STATISTICAL UPDATE 1990 provides updated 1989 data collected in 1990 and provisional for 1990.

0520 Waste Management

Refer also to citation(s) 12459, 12460, 12461, 12462, 12464, 12556, 12561, 12565, 12784, 12848, 13024, 13108, 13109, 13117, 13153, 13160, 13180, 13185, 13195, 13204, 13205, 13206, 13210, 13460, 13461, 13462, 13463, 13464, 13465, 13466, 13467, 13468, 13469, 13470, 13471, 13485, 13504, 13918

12469 (ANL–90/40) **Unsaturated glass testing for DOE Program in Environmental Restoration and Waste Management: Annual report, October 1989–September 1990.** Bates, J.K. (Argonne National Lab., IL (USA)); Bradley, C.R.; Dietz, N.L.; Ebert, W.L.; Emery, J.W.; Gerding, T.J.; Hoh, J.C.; Mazer, J.J.; Young, J.E.; Bradley, J.P. Argonne National Lab., IL (USA). Jan 1991. 64p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91007985. Source: OSTI; NTIS; INIS; GPO Dep.

A program has been established for DOE Environmental Restoration and Waste Management (EM) to evaluate factors that are likely to affect waste glass reaction in an unsaturated environment typical of what may be expected for the candidate Yucca Mountain repository site. This report covers progress in FY 1990 on the following five tasks: (1) A critical review of those parameters that affect the reactivity of glass in an unsaturated environment is in progress. This effort involves a search of literature to identify the important parameters. Temperature is the first parameter examined in detail, and a draft report has been completed. (2) A series of tests has been started to evaluate the reactivity of fully radioactive glasses in a high-level waste repository environment and compare it to the reactivity of synthetic glasses of similar composition. (3) The effect of radiation upon the durability of waste glasses at a high glass surface area-to-liquid volume (SA/V) ration and high gas-to-liquid volume ratio will be assessed. The conditions of these tests will be typical of an unsaturated environment. (4) A series of tests is being performed to compare the extent of reaction of nuclear waste glasses at various SA/V ratios. Such differences in the SA/V ratio may significantly affect glass durability. (5) Analytical electron microscopy is being used to assess the glass/water reaction pathway by identifying intermediate phases that appear on the reacting glass. 25 refs., 17 figs., 12 tabs.

12470 (BfS-ET–2/90) **Continuation of the summarizing interim report on previous results of the Gorleben site survey as of May 1983.** Bundesamt fuer Strahlenschutz, Braunschweig (Germany, F.R.). Fachbereich Nukleare Entsorgung und Transport. Apr 1990. 300p. (In German). Order Number DE91759428. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to results from the 1983 interim report, this report contains, in order to supplement the surface explorations, seismic reflection measurements, hydrogeologic and seismologic investigations, sorption experiments, and studies of glacial development in the site region and of long-term safety of final waste repositories in salt domes. The site's high grade of suitability for becoming a final radioactive waste repository, the legal basis as well as quality assurance are evaluated. (orig.).

12471 (BNWI–1006) **Explosion of cation exchange column in americium recovery service Hanford Plant, August 30, 1976.** Battelle-Northwest, Richland, WA (USA). Pacific Northwest Lab. 8 Oct 1976. 63p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91007084. Source: OSTI; NTIS; INIS; GPO Dep.

A cation exchange column in americium recovery service exploded on August 30, 1976 at the Hanford plutonium-finishing plant operated by Atlantic Richfield Hanford Company for the Energy Research and Development Administration at Richland, Washington. The column burst, shattering the glovebox windows. Detectable but small amounts of americium were released from the building in which the explosion occurred. Decontamination efforts and physical repairs to equipment and facilities are estimated to cost less than $500,000. The probable cause of the explosion of the cation exchange column is an exothermic reaction between 7 molar nitric acid and radiation-produced degradation products from the resin (Dowex 50W-X8). The postulated chemical reaction caused pressure to build within the column until the strength of the six-inch diameter, schedule-ten, stainless-steel pipe was exceeded and the column exploded. Radiation from the more than 100 grams of americium on the cation resin for over five months caused the resin degradation. This report covers only the explosion of the cation exchange column and closely related major events and actions. 30 refs., 6 figs.

12472 (CEA-CONF–10433) **New extractants for the treatment of nuclear waste solutions.** Cuillerdier, C.; Musikas, C.; Hoel, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1990. 13p. (CONF-9009364–: Extraction'90 Meeting, Dounreay (UK), 10-14 Sep 1990). Order Number DE91757112. Source: OSTI; NTIS (US Sales Only).

Pentaalkyl propane diamides are studied in Fontenay-aux-Roses to extract α emitters from nitric acid solutions of nuclear wastes. Their formula is $(RR'NCO)_2$ CHR with R and R' alkyl radicals R" alkyl or oxyalkyl one. Main features concerning the chemistry of these solvents are given. A molecule with $R=CH_3$ $R'=C_4H_9$ and $R"=C_2H_4\text{-}O\text{-}C_6H_{13}$ has been selected for practical applications. The results of an experiment realised in a mixer-settler battery to treat a real solution of wastes were described.

12473 (CEA-DAS–667) **Geochemical modelling: what phenomena are missing.** Jacquier, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Dec 1989. 18p. (CONF-891120–: Migration '89: 2nd international conference on chemistry and migration behavior of actinides and fission products in the geosphere, Monterey, CA (USA), 6-10 Nov 1989). Order Number DE91752683. Source: OSTI; NTIS (US Sales Only).

In the framework of safety assessment of radioactive waste disposal, retention phenomena are usually taken into account by the Kd concept. It is well recognized that this concept is not enough for safety assessment models, because of the several and strong assumptions which are involved in this kind of representation. One way to have a better representation of the retention phenomena, is to substitute for this Kd concept an explicit description of geochemical phenomena and then couple transport codes with geochemical codes in a fully or a two-step procedure. We use currently such codes, but the scope of this paper is to display the limits today of the geochemical modelling in connection with sites analysis for deep disposal. In this paper, we intend to give an overview of phenomena which are missing in the geochemical models, or which are not completely introduced in the models. We can distinguish, on one hand phenomena for which modelling concepts exist such as adsorption/desorption and, on the other hand, phenomena for which modelling concepts do not exist for the moment such as colloids, and complexation by polyelectrolyte solutions (organics). Moreover we have to take care of very low concentrations of radionuclides, which can be expected from the leaching processes in the repository. Under those conditions, some reactions may not occur. After a critical review of the involved phenomena, we intend to

stress the main directions of the wishful evolution of the geochemical modelling. This evolution should improve substantially the quality of the above-mentioned site assessments.

12474 (CONF-910270–17) **Waste handling and packaging plant project description.** Turner, D.W.; Moore, J.W.; Conatser, D.A. Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From Waste management '91; Tucson, AZ (USA); 24-28 Feb 1991. Order Number DE91008368. Source: OSTI; NTIS; INIS; GPO Dep.

ORNL currently has about 300 m^3 of remote handled transuranic (RHTRU) solid waste retrievably stored in trenches and a bunker. This material will be processed through the Waste Handling and Packaging Plant (WHDP) for shipment to the Waste Isolation Pilot Plant (WIPP). Details of siting, construction, and conceptual flow of RHTRU waste through the plant are provided. ORNL also has liquid waste and sludge stored in the Melton Valley Storage Tanks (MVST). The sludge also contains TRU waste, and the WHPP will process an expected volume of 500,000 gallons of a suernatant/sludge slurry for shipment to the WIPP. Specific systems which require more development include the cask transfer system, the linear accelerator-based nondestructive assay and nondestructive evaluation equipment. (MHB)

12475 (CONF-910270–18) **An overview of the ORNL Waste Handling and Packaging Plant.** Mason, R.C.; Turner, D.W.; Berry, J.B. Oak Ridge National Lab., TN (USA). [1991]. 3p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From Waste management '91; Tucson, AZ (USA); 24-28 Feb 1991. Order Number DE91008392. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. ORNL/radioactive waste facilities; ALPHA-BEARING WASTES/radioactive waste processing; ORNL; WIPP; REMOTE HANDLING; STORAGE FACILITIES; WASTE TRANSPORTATION; TRANSPORT REGULATIONS; CONSTRUCTION; PACKAGING; DESIGN; SLUDGES; SLURRIES

12476 (DOE/NV/10461–T42) **Estimating the economic impact of a repository from scenario-based surveys: Models of the relation of stated intent to actual behavior.** Easterling, D. (Pennsylvania Univ., Philadelphia, PA (USA). Center for Risk and Decision Processes); Morwitz, V.; Kunreuther, H. Nevada Nuclear Waste Project Office, Carson City, NV (USA); Pennsylvania Univ., Philadelphia, PA (USA). Center for Risk and Decision Processes. Dec 1990. 165p. Sponsored by USDOE,. DOE Contract FG08-85NV10461. (NWPO-SE–035-90). Order Number DE91008214. Source: OSTI; NTIS; INIS; GPO Dep.

The task of estimating the economic impact of a facility as novel and long-lived as a high-level nuclear waste (HLNW) repository is fraught with uncertainty. One approach to the forecasting problems is to survey economic agents as to how they would respond when confronted with hypothetical repository scenarios. A series of such studies conducted for the state of Nevada have examined the potential impact of a Yucca Mountain repository on behavior such as planning conventions, attending conventions, vacationing, outmigration, immigration, and business location. In each case, respondents drawn from a target population report on whether a particular repository event (either some form of an accident, or simply the presence of the facility) would cause them to act any differently than they otherwise would. The responses to such a survey provide an indication of whether or not economic behavior would be altered. However, the analysis is inevitably plagued with the question of how much credence to place in the reports of intended behavior; can we believe what people report they would do in a hypothetical situation? The present study examines a more precise version of this question regarding the validity of stated intent data. After reviewing a variety of literature in the area of intent versus actual behavior, we provide an answer to the question, "What levels of actual behavior are consistent with the intent data that have been observed in the repository surveys?" More formally, we assume that we are generally interested in predicting the proportion of a sample who will actually perform a target behavior. 86 refs., 6 figs., 9 tabs.

12477 (DOE/RW–0268-Rev.1P) **Waste management system requirements document: Volume 4, MGDS: Revision 1.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Feb 1991. 38p. Sponsored by USDOE, Washington, DC (USA). Source: OSTI (Free of Charge); INIS.

This volume defines the top level requirements for the Mined Geologic Disposal System (MGDS). It is designed to be used in conjunction with Volume 1 of the WMSR, General System Requirements. It provides a functional description expanding the requirements allocated to the MGDS in Volume 1 and elaborates on each requirement by providing associated performance criteria as appropriate. Volumes 1 and 4 of the WMSR provide a minimum set of requirements that must be satisfied by the final MGDS design. This document sets forth specific requirements that must be fulfilled. It is not the intent or purpose of this top level document to describe how each requirement is to be satisfied in the final MGDS design. Each subsequent level of the technical document hierarchy must provide further guidance and definition as to how each of these requirements is to be implemented in the design. It is expected that each subsequent level of requirements will be significantly more detailed. Section 2 of this volume provides a functional description of the MGDS. Each function is addressed in terms of requirements, and performance criteria. Section 3 provides a list of controlling documents. Each document cited in a requirement of Chapter 2 is included in this list and is incorporated into this document as a requirement on the final system. The WMSR addresses only federal requirements (i.e., laws, regulations and DOE orders). State and local requirements are not addressed. However, it will be specifically noted at the potentially affected WMSR requirements that there could be additional or more stringent regulations imposed by a state or local requirements or administering agency over the cited federal requirements.

12478 (DOE/RW–0299P) **Office of Civilian Radioactive Waste Management annual report to Congress.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Dec 1990. 65p. Sponsored by USDOE,. Source: INIS; OSTI (Free of Charge).

This seventh Annual Report to Congress by the Office of Civilian Radioactive Waste Management (OCRWM) describes activities and expenditures of the Office during fiscal years (FY) 1989 and 1990. In November 1989, OCRWM is responsible for disposing of the Nation's spent nuclear fuel and high-level radioactive waste in a manner that protects the health and safety of the public and the quality of the environment. To direct the implementation of its mission, OCRWM has established the following objectives: (1) Safe and timely disposal: to establish as soon as practicable the ability to dispose of radioactive waste in a geologic repository licensed by the NRC. (2) Timely and adequate waste acceptance: to begin the operation of the waste management system as soon as practicable in order to obtain the system development and operational benefits that have been identified for the MRS facility. (3) Schedule confidence: to establish confidence in the schedule for waste acceptance and disposal such that the management of radioactive waste is not an obstacle to the nuclear energy option. (4) System flexibility: to ensure that the program has the flexibility necessary for adapting to future circumstances while fulfilling established commitments. To achieve these objectives, OCRWM is developing a waste management system consisting of a geologic repository for permanent disposed deep beneath the surface of the earth, a facility for MRS, and a system for transporting the waste.

12479 (DOE/WIPP–89-015) **Brine Sampling and Evaluation Program: 1988 report.** Deal, D.E. (I. T. Corp., Albuquerque, NM (USA)); Abitz, R.J.; Case, J.B.; Crawley, M.E.; Deshler, R.M.; Drez, P.E.; Givens, C.A.; King, R.B.; Myers, J.; Pietz, J.M.; Roggenthen, W.M.; Tyburski, J.R.; Belski, D.S.; Lauctes, B.A.; Niou, S.; Wallace, M.G. Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. Dec 1989. 509p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-86AL31950. Order Number DE91008821. Source: OSTI; NTIS; INIS; GPO Dep.

The data presented in this report are the result of Brine Sampling and Evaluation Program (BSEP) activities at the Waste Isolation Pilot Plant (WIPP) during 1988. These activities, which are a continuation and update of studies that began in 1982 as part of the Site Validation Program, were formalized as the BSEP in 1985 to document and investigate the origins, hydraulic characteristics, extent, and composition of brine occurrences in the

Permian Salado Formation, and seepage of that brine into the excavations at the WIPP. Previous BSEP reports (Deal and Case, 1987; Deal and others, 1987) described the results of ongoing activities that monitor brine inflow into boreholes in the facility, moisture content of the Salado Formation, brine geochemistry, and brine weeps and crusts. The information provided in this report updates past work and describes progress made during the calendar year 1988. During 1988, BSEP activities focused on four major areas to describe and quantify brine activity: (1) monitoring of brine inflow parameters, e.g., measuring brines recovered from holes drilled upward from the underground drifts (upholes), downward from the underground drifts (downholes), and near-horizontal holes; (2) characterizing the brine, e.g., the geochemistry of the brine and the presence of bacteria and their possible interactions with experiments and operations; (3) characterizing formation properties associated with the occurrence of brine; e.g., determining the water content of various geologic units, examining these units in boreholes using a video camera system, and measuring their resistivity (conductivity); and (4) modeling to examine the interaction of salt deformation near the workings and brine seepage through the deforming salt. 77 refs., 48 figs., 32 tabs.

12480 (DOE/WIPP–89-025) **Waste characterization program plan for WIPP experimental waste.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. Jan 1991. 37p. Sponsored by USDOE,. DOE Contract AC04-86AL31950. Order Number DE91008621. Source: OSTI; NTIS; INIS; GPO Dep.

This program plan is being issued by the Department of Energy (DOE) to reflect the current status of the waste characterization program. Not all methods of compliance with the requirements imposed by the regulators have been fully developed. Although the Environmental Protection Agency has issued the Conditional No-Migration Determination for the Waste Isolation Pilot Plant (WIPP), several activities have to be studied for recommendations of optimum courses of action. Therefore, as the DOE determines compliance methodologies for the requirements of the No-Migration Determination and for the requirements of the New Mexico Environmental Improvement Division, this program plan will be revised and reissued as often as necessary. It should also be understood that the DOE will comply with all regulations prior to making any shipment of transuranic waste to the WIPP for the experiments. 14 refs., 4 figs., 5 tabs.

12481 (DP–1778) **Integrated report on radionuclide migration at the Savannah River shallow land burial site.** Towler, O.A. Jr. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. Mar 1989. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE91009303. Source: OSTI; NTIS; INIS; GPO Dep.

The impact of the SRP Solid Radioactive Waste Burial Ground on the environment has been studied since the early 1970s in four subtasks: subsurface monitoring of groundwater, lysimeter tests of waste, soil-water chemistry effects, and radionuclide transport modeling. This document summarizes and integrates the results of the four subtasks. More information has been gathered on the behavior of radionuclides in a solid waste disposal facility located in a humid region than from any other waste disposal site in the world. The design of closure for the SRP Burial Ground has been given a firm technical basis. The limiting pathways for radionuclide migration have been determined to be infiltrating rainwater and root penetration. Closure designs must therefore address both these factors. The designs for new storage/disposal facilities have also been given a firm technical basis. The major conclusions are that tritium will be stored for decay and not allowed to contact the groundwater, waste containing long-lived radionuclides such as iodine-129 must be stored for later geologic disposal, and above and below ground concrete vaults should be used for disposal of other low-level radioactive waste. 61 refs., 18 figs. 8 tabs.

12482 (EUR–12672) **Thermodynamic study of the radionuclide non-dominant transport processes in the geosphere.** Fargue, D. (Ecole Nationale Superieure des Mines, 77 - Fontainebleau (FR). Centre d'Information Geologique): Goblet, P.; Jamet, Ph. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 166p. (In French). contract no FI1W/0167. Source: OSTI; NTIS (US Sales Only).

Most of the numerous physical and chemical phenomena inducing mass transfer in the geosphere are usually neglected, which we refer to as the non-dominant transport processes. The peculiar conditions of the radioactive waste disposals might give some importance to some of these effects. It is therefore useful to investigate those effects and take them into account for further safety studies. This concern has given rise to the present work. First we focused our attention on the mathematical formalism describing the relationships between the physical and chemical gradients and the induced mass fluxes. This approach is based on Irreversible Thermodynamics. This scattered work required a more adapted presentation to our scientific purposes. This first part allowed us to draw some orders of magnitude concerning three main effects: the Soret effect, the thermogravitational effect and the sedimentation effect. The temperature-induced phenomena seem to have more importance than others. One may add that due to the thermal field settling in the vicinity of the buried waste, these processes could have some consistency. The third section is devoted to the phenomena involving the electromagnetic field. This work is part of the community programme Mirage.

12483 (EUR–12704) **Faulting in mudrocks: the selection of potential research sites.** Alexander, J. (British Geological Survey, Keyworth (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 51p. Contract No FI1W/0085. Source: OSTI; NTIS (US Sales Only).

The British Geological Survey, in cooperation with Ismes of Italy, has carried out a research programme into faults through clay formations. The research programme commenced in April 1986 and work started at the Down Ampney site in February 1987.

12484 (EUR–12763) **Study of industrial operation of radioactive waste solidification plants from the point of view of quality assurance.** Ganser, B. (Nuklear-Chemie und-Metallurgie G.m.b.H (NUKEM), Hanau (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 160p. (In German). Source: OSTI; NTIS (US Sales Only).

This final report describes the industrial operation of the following radioactive waste processing plants: ROBE concentration plant from REW BV Biblis, MOWA cementation plant from the ex-Transnuclear Company, the high-pressure press and the continuous mixer from NUKEM Company. The level of qualification of plants quoted in the report follow a declaration of the PTB (physico-technical Federal Department) favourable to the Konrad storage plant. The level is evaluated by comparison to other qualification processes concerning similar facilities. Known experimental principles of this qualification are evidenced and completed if necessary. Experimental results and operation experience are listed in procedures written from information given by the testing section of the PTB.

12485 (EUR–12796) **Software quality assurance procedures for radioactive waste risk assessment codes.** Hill, I.; Mayer, J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 148p. Contracts PECD 7/9/384. H2C 618390 T, FI1W-0039-UK. Source: OSTI; NTIS (US Sales Only).

This support study for the evaluation of the safety of geological disposal systems is aimed at identifying the requirements for software quality assurance procedures for radioactive waste risk assessment codes, and to recommend appropriate procedures. The research covers: (i) the analysis of existing procedures and definition of requirements; (ii) a case study of the use of some existing procedures; (iii) the definition and the implementation of procedures. The report is supported by appendices that give more detail on the procedures recommended. It is intended to provide ideas on the steps that should be taken to ensure the quality of the programs used for assessment of the safety case for radioactive waste repositories, and does not represent the introduction of wholly new ideas or techniques. The emphasis throughout is on procedures that will be easily implemented, rather than on the fully rigorous procedures that are required for some application areas. The study has concentrated on measures that will increase the confidence in repository performance assessments among the wider scientific/engineering community, and the lay public.

12486 (EUR–12815) **Conditioning for definitive storage of radioactive graphite bricks from reactor decommissioning.** Costes, J.R. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Koch, C.; Tassigny, C. de; Vidal, H.; Raymond, A. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 86p. (In French). Contrat no. FI1D-0064. Source: OSTI; NTIS (US Sales Only).

The decommissioning of gas-graphite reactors in the EC (e.g. French UNGGs, British Magnox reactors and AGRs, and reactors in Spain and in Italy) will produce large amounts of graphite bricks. This graphite cannot be accepted without particular conditioning by the existing shallow land disposal sites. The aim of the study is to examine the behaviour of graphite waste and to develop a conditioning technique which makes this waste acceptable for shallow land disposal sites. 18 kg of graphite core samples with an outside diameter of 74 mm were removed from the G2 gas-cooled reactor at Marcoule. Their radioactivity is highly dependent on the position of the graphite bricks inside the reactor. Measured results indicate an activity range of 100-400 MBq/kg with 90% Tritium, 5%$_{14}$C, 3%$_{60}$Co, 1.5%$_{63}$Ni. Repeated porosity analyses showed that open porosity ranging from 0 to 100 μm exceeded 23 vol% in the graphite. Water penetration kinetics were investigated in unimpregnated graphite and resulted in impregnation by water of 50-90% of the open porosity. Preliminary lixiviation tests on the crude samples showed quick lixidegree of Cs (several per cent) and of ^{60}Co, and ^{133}Ba at a lesser degree. The proposed conditioning technique does not involve a simple coating but true impregnation by a tar-epoxy mixture. The bricks recovered intact from the core by robot services will be placed one by one inside a cylindrical metallic container. But this container may corrode and the bricks may become fragmented in the future, the normally porous graphite will be unaffected by leaching since it is proved that all pores larger than 0.1 μm will be filled with the tar-epoxy mixture. This is a true long-term waste packaging concept. The very simple technology required for industrial implementation is discussed.

12487 (EUR–12840) **Radionuclide migration in the geosphere: modelling of the natural analogue of needle's eye.** Doublet, R. (Ecole Nationale Superieure 77 - Fontainebleau (FR). Centre d'Information Geologique); Jamet, P.; Lachassagne, P.; Ledoux, E. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 96p. (In French). Contrac no FI1W/0070. Source: OSTI; NTIS (US Sales Only).

The study of the natural analogue of Needle's Eye (Scotland) has covered a three years period. It involved an important field and laboratory work, though delicate considering the peculiar site constraints (which is a natural reserve). The collaboration between BGS and SURRC geologists and geochemists on the one hand, and the modelling team of CIG on the other hand made it possible to collate an adequate and consistent database prior to a fruiful modelling work. In conclusion, the work that has been carried out enlights the applicability of a coupled model to a real case. This approach could be extended to other case studies. However, an important work remains to be done in order to strenghten the first encouraging results of the Needle's Eye model. This work is part of the community programme Mirage.

12488 (EUR–12874) **Contamination immobilization by polymer coating of large-sized radioactive wastes for storage.** Tassigny, C. de (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR)); Signoret, C. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 53p. (In French). Contract no FI1D-0018. Source: OSTI; NTIS (US Sales Only).

The aim of the research work is the development of new techniques to fix contamination and the containment of radioactive waste by using polyurethane paints. The following main work steps have been carried out: . Determination of the polyurethane paint most suited for this application based on water diffusion tests and diffusion of radio-elements . Choice of the spraying technique with respect to conditions of an ionizing environment . Pilot application of the technique on a dismantling site. The polyurethane paint selected is a solventless bicomponent paint manufactured by Bayer. The spraying device chosen (Isotherm PMS 70) and fitted with a Gusmer-Getrasur spray gun is able to operate in an ionizing environment under satisfactory conditions (tested on two pilot work sites). The process generates no contaminated aerosols, but ensures perfect fixation of the ionizing particles. ANDRA has given its agreement for storage in one of its sites of 12 alpha contaminated cast iron slabs (total weight: 60 tons) on which one ton of polyurethane has been applied.

12489 (EUR–12911) **Decontamination of concentrated medium level radioactive wastes by a chromatographic method.** Faubel, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE)); Mehret, R.; Menzler, P.M. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 82p. (In German). Vertrag Nr. FI1W/0022 D. Source: OSTI; NTIS (US Sales Only).

The technical feasibility of partitioning concentrated nitric acid intermediate-level waste (ILWC) solutions from the Purex process into a small volume of high-level waste and a large volume of low-level waste using sorption methods is demonstrated for 1-l and 11-l batches. Cesium-134 and 137 are selectively separated with a decontamination factor (DF) > 1 x 10^5 in a newly developed suspended-bed column filled with the microporous inorganic exchanger ammonium molybdophosphate. The ^{125}Sb and the actinides and lanthanides (3 +) are retained with DFs between 40 and 1000 on metal oxides of Sb and Mn and on an extraction column containing n-octyl (phenyl)N,N-disobutyl carbamoyl methyl phosphine oxide, respectively. Ruthenium-106 and ^{60}Co are removed in a column loaded with dimethyl glyoxime and have DFs > 20. The amount of secondary wastes arising from absorber materials was estimated on the basis of 1 l experiments to be 300 kg for a 350 t/yr reprocessing plant with an ILWC volume of about 0.5 m^3/t of heavy metal. One of the main goals was to check out the influence of a scaling up from laboratory scale to pilot plant operations. The hydraulic behaviour of the apparatus was tested for 1, 20, and 100 liters of solutions. The second important aim was to reach a decontamination of the ILWC, sufficient to meet the requirements of regulations limiting the dose to 2 mSv/h at a 1-m distance, calculations with the PROMAX program, for cementing the LLW effluent into 400-l drums at a 10 wt% loading, lead to a value of about 100 μSv/h; thus, this waste can be handled without any shielding. The secondary waste can be treated individually.

12490 (EUR–12912) **Centrifugation of low-level radioactive effluents from a PWR plant.** Roofthooft, R.; Calay, J.C. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 197p. (In French). Contract no FI1W-0007 (GDF). Source: OSTI; NTIS (US Sales Only).

The major aim of this study, subsidized by the Commission of the European Communities, was the development of a process enabling treatment of non-recoverable waste from the Tihange power plant, in order to reduce both the rejected activity and the final product to be disposed in barrels. A flocculation procedure has been worked out for each waste type, i.e. residual, service, laundry, decontamination, pool and regeneration wastes. The influence of products that might disturb this flocculation and the method enabling their elimination have been investigated. In order to reduce the waste amount, a centrifugation pilot plant with a rated flow of 800 l/h has been developed. It has been operated jointly with an industrial batch flocculation (35 m^3) located in Tihange. Finally comparative tests have been performed in the Tihange power plant, using both the UKAEA and LABORELEC processes on the same waste product.

12491 (EUR–12935) **The Community's R and D programme on management and storage of radioactive waste.** McMenamin, T. (Commission of the European Communities, Brussels (BE)). Commission of the European Communities, Luxembourg (Luxembourg). May 1990. 64p. Source: OSTI; NTIS (US Sales Only).

This list of publications covers reports, proceedings, communications and information leaflets produced and published in the frame of the cost-sharing research programme of the Commission of the European Communities on radioactive waste management and disposal. The list, which is regularly updated, includes: (i) reports of contractors on research supported by the Commission; (ii) reports on research in coordinated actions, assembled and edited by the Commission staff or on behalf of the Commission; (iii) proceedings of meetings, conferences and workshops organized and edited by the Commission staff; (iv) scientific reports, communications, annual progress reports and information leaflets produced and edited

by the Commission staff. Not included are contributions of contractors and staff to national or international meetings, workshops, conferences and expert groups. Work performed by the Commission's Joint Research Centre (JRC) in the field of radioactive waste management is not mentioned here - information on the JRC activities and publications may be found in the annual JRC progress reports and the bi-annual information leaflet EC-Focus.

12492 (EUR–13008) **In situ processing of concrete surface by impregnation and polymerization of an organic resin.** Pellecchia, V. (SNIA, Rome (IT)); Ursella, P.; Moretto, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 30p. (In Italian). Contratto di ricerca N. FI1D-0055. Source: OSTI; NTIS (US Sales Only).

The impregnation by resins of concrete structures is widely known as PIC (Polymer Impregnated Concrete). This process is normally used to improve the physical-chemical features of prefabricated items in particular to raise their lifetime under severe environmental conditions. The main target of this research contract was the verification of the possibility of a proper impregnation of existing concrete surfaces, of any dimensions and position, by comparing the obtained characteristics with those of untreated original material to check the improvement of chemical-physical properties and durability. In a nuclear facility, this goal is very important with reference to the long-term integrity of concrete walls during plant operative lifetime and after the final shutdown and decommissioning of the plant, if its dismantling is deferred. The operative steps of the research were the design, manufacturing and implementation of a tailored prototype equipment, the setting-up of the machine, the project and erection of a walling unit made of different density sectors in nuclear grade concrete and optimisation of the PIC process phases (dehydration, degassing, monomer injection, thermal cycles) during the experimental campaign. The data collected from samples gathered from field application gave results very similar to laboratory impregnated samples, thus confirming the satisfactory running of the prototype unit. Particularly the resin penetration, in spite of low porosity of nuclear grade concrete matrix, reached depths well beyond 50 mm with a significant increase of mechanical features, leaching resistance to aggressive agents and an appreciable sealing of concrete porosity.

12493 (EUR–13018) **Practice of handling radioactive wastes outside the nuclear fuel cycle in Federal Republic of Germany.** Kals, A. (Gesellschaft fuer Reaktorsicherheit mbH (GRS) Koeln (DE)); Pfeffer, W.; Urban, H. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 147p. (In German). Contract No FI1W-0238. Source: OSTI; NTIS (US Sales Only).

The report presents the handling of radioactive wastes, which are not produced in facilities of the nuclear fuel cycle. The actual amounts of radioactive waste are given showing also the fractions coming from institutions under consideration with respect to the total amount. For different areas as institutions producing radioactive waste, plants conditioning the waste, storing facilities or for the planned final repository the practice of handling, conditioning or storing is described; different methods are discussed. As far as possible and reasonable hints or recommendations are worked out. In some areas problems could be identified, e.g. some nuclides as tritium or radium, are not easily conditioned for a final repository, the lack of final prescriptions how to process the waste for the final repository, differing conditions for the waste to be transferred to the intermediate storage facilities, lack of guidelines how to analyse the waste contaminated with short-lifed nuclides after the decay-time before it is deposited, and the lack of harmonized and perhaps centralized facilities to process the waste before it will be stored in the final repository. Facilities should be capable to cope with non-radioactive aspects as chemical or toxic aspects during processing. It may be summarized, that the handling of radioactive waste produced in non-fuel cycle facilities in general has been regulated and planned for the complete line from the beginning to the repository. Though there are still some aspects as those summarized above that may and should be improved.

12494 (EUR–13027) **Conditioning ashes from combustion plant in a special melting furnace.** Ganser, B. (Nuklear-Chemie und Metallurgie G.m.b.H. (NUKEM), Hanau (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 102p. (In German). Contract No FI1W-0010. Source: OSTI; NTIS (US Sales Only).

In this final report we describe the development of a melting process for radioactive ashes. A literature survey was performed to define the state of the art of the melting technique and to get actual data about ash compositions. Based on these results the in-can-melting-process was elected for further development. Based on the literature data of ash compositions inactive simulates were compiled and mixed. Additives for melting point reduction were systematically investigated. An addition of 50% by weight of $Na_2B_4O_7$ (concerning ash weight) was found to be sufficient for the melting of all used simulates at 1000 ^{o}C, only 30% at 1300 ^{o}C. Samples of these products were investigated for their leach resistance of waste elements (Cs, Co, Eu etc.) and matrix elements (B, Al). They showed similar low leach rates like vitrified HAW. Full scale melting tests were performed with the Naber-furnace and the LINN-furnace. Based on the experiments a concept for a hot facility was designed. A cost estimation showed for the melting process prices of about 19 DM/kg ash compared with 10-15 DM/kg ash for cementation and highforce compaction.

12495 (EUR–13053) **Immobilization in cement of ion exchange resins from Spanish nuclear reactors.** Huebra, A.G. de la (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas Madrid (ES)); Murillo, R.; Ortiz, S.J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 144p. (In Spanish). Contrato no FI1W/0142. Source: OSTI; NTIS (US Sales Only).

Ion exchange materials used at nuclear power plants can be immobilized in cements less expensive than polymer matrices. Cement solidification of spent ion exchange resins shows swelling and cracking troubles (during setting time, or of storage). The objective of this study was to select the types of cement that produce the best quality on immobilization of three kinds of resins and to set up cement formulations containing the maximum possible loading of resin. Four cements were selected to carried out the study. After a study of hydration-dehydration phenomena of ion exchange resins, a systematic work has been carried out on immobilization. Tests were performed to study compressive strength and underwater stability by changing water/cement ratio and resin/cement ratio. Mixtures made with water, cement and resin only were loaded with 10% by weight dry resin. Mixtures with higher loadings show poor workability. Tests were carried out by adding organic plasticizers and silica products to improve waste loading. Plasticizers reduced water demand and silica products permit the use of more water. Leaching tests have been performed at 40^{o}C. In conclusion Blast Furnace Slag is the best cement for immobilization of ion exchange resin both bead and powdered form for mechanical strength, stability and leaching.

12496 (FRCEA-TH–327) **Contribution to the study of nuclear waste slurry concentration. Tangential microfiltration on mineral membranes made of ferric hydroxide suspension in highly saline media.** De Bank, P. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Aix-Marseille-3 Univ., 13 - Marseille (France). Sep 1990. 151p. (In French). Order Number DE91752689. Source: OSTI; NTIS (US Sales Only).

In this thesis are presented first results on volume reduction of low and medium activity nuclear wastes by concentration of solid matter in suspension with a tangential microfiltration process. Physicochemistry and rheology of a ferric hydroxide suspension in nitrate medium are studied. Permeation laws and ultrafiltration membrane fouling show the formation of a solid deposit on the membrane surface and influence of operation parameters. A model of deposit erosion is presented to explain local phenomena during filtration.

12497 (GEFR–00482) **Actinide recycle in LMFBRs as a waste management alternative.** Beaman, S.L. General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept. 21 Aug 1979. 112p. Sponsored by USDOE,. DOE Contract AM03-76SF00893. Order Number DE91007426. Source: OSTI; NTIS; INIS; GPO Dep.

A strategy of actinide burnup in fast reactor systems has been investigated as an approach for reducing the long term hazards and storage requirements of the actinide waste elements and their decay daughters. The actinide recycle studies also included plutonium burnup studies in the event that plutonium is no longer required as a fuel. Particular emphasis was placed upon the timing of the recycle program, the requirements for separability of the waste materials, and the impact of the actinides on the reactor operations and performance. It is concluded that actinide recycle and plutonium burnout are attractive alternative waste management concepts. 25 refs., 14 figs., 34 tabs.

12498 (GSF–15/90) **The HAW-project: Demonstration facility for the disposal of high-level waste in salt. Interim report 1988-1989.** Rothfuchs, T.; Duijves, K.A.; Mueller-Lyda, I. Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung; Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1990. 197p. Contract BMFT KWA 8507-1;CEC FI-1W-0003-D(B). (GSF-TL–8/90). Order Number DE91756241. Source: OSTI; NTIS (US Sales Only); INIS.

To satisfy the test objectives thirty highly radioactive canisters containing the radionuclides Cs-137 and Sr-90 will be emplaced in six boreholes located in two test galleries at the 800 m-level in the Asse salt mine. For handling of the radioactive canisters and their emplacement into the boreholes a system consisting of a transport cask, a transport vehicle, a disposal machine, and of a borehole slider has been developed. The actual scientific investigation programme is based on the estimation and observation of the interaction between the radioactive canisters and the rock salt. This programme includes measurement of thermally and radiolytically induced water and gas release from the rock salt and the radiolytical decomposition of salt minerals. Also the thermally induced stress and deformation fields in the surrounding rock mass will be investigated carefully. (orig./DG).

12499 (GSF–24/90) **Test measurements by radar tomography and reflection in Asse salt deposits.** Yaramanci, U.; Flach, D. Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1990. 79p. (In German). Contract BMFT KWA 5603A6. (GSF-TL–18/90). Order Number DE91756221. Source: OSTI; NTIS (US Sales Only); INIS.

The dam construction field at 900 m depth, which is subjected to a brine injection experiment, was selected as test area. The attenuation tomogram shows two distinct, long-stretched zones of high attenuation, which is indicative of increased fracturing and moisture. The drift-near area at floor level is also slightly more humid than the surroundings. The test measurements prove that the radar method contributes towards providing information on the geology, structure and presence of brine in the Asse mine. (DG).

12500 (GSF–27/90) **Radiation protection and environmental monitoring in the area of the Asse shaft plant. Annual report 1989.** Meyer, H.; Mueller-Lyda, I. Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung. Aug 1990. 44p. (In German). (GSF-TL–28/90). Order Number DE91759438. Source: OSTI; NTIS (US Sales Only); INIS.

Personnel monitoring has been carried through in compliance with the Radiation Protection Ordinance. Environmental monitoring including measurement of local doses, local dose rates, and airborne radioactivity in the shaft has been made according to the provisions for radiation protection at the place of work. Maximum permissible personal doses or activity levels for occupationally exposed persons have not been exceeded in the reporting period. Exhaust air monitoring detected the nuclides H-3, C-14, Pb-210, and the short-lived daughter products of Rn-222 and Rn-220. The activity concentrations in the environment, determined from the measured annual release values, for some part have been lower than the average of natural concentrations of said nuclides. The radiation exposure due to emissions, measured at the least favourable point in the environment, has been far below the limits set by the Radiation Protection Ordinance. In conclusion: The radiation exposure of the personnel and of the population in the area of the Asse shaft plant due to the storage of radioactive is low, compared to the natural radiation exposure. (orig.).

12501 (HW–57289) **Leak detection system for self-boiling, high-level, radioactive wastes storage tanks (scope and design criteria).** Stivers, H.W. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 7 Oct 1958. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009406. Source: OSTI; NTIS; GPO Dep.

The leak detection system presented in this document would supplement the existing test wells and instrumentation system at Purex tank farm 241-A and Redox tank farm 241-SX. The system would provide an access for radiation detection instrumentation beneath the waste storage tanks without subjecting personnel to abnormal radiation conditions. Small or low rates of leakage from boiling tanks could remain undetected with the existing detection equipment. Material balances can be used on specific gravity, but are questionable at the best, since accurate measurements of sludge volume and density are difficult to obtain. Additional instrumentation for a material balance would not provide adequate accuracy to define small leaks. Heat balances are cumbersome and rely on the heat loss to ground for their accuracy. Heat loss to ground is a variable that has not been accurately calculated.

12502 (HW–73285) **Solvent extraction of cesium by dipicrylamine: I. Initial laboratory studies and hot-cell demonstration.** Bray, L.A.; Martin, E.C.; Moore, R.L.; Roberts, F.P. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 2 Apr 1962. 47p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009595. Source: OSTI; NTIS; GPO Dep.

The work described in this report was undertaken to broaden Hanford's knowledge of radiocesium recovery to include solvent extraction and complement the extensive work which has been in progress for a number of years on carrier precipitation and ion-exchange techniques. Possible advantages of solvent extraction, if an efficient, economical extractant can be found, would include (1) easier integration with solvent extraction processes now being contemplated for other fission products such as strontium, cerium, and rare earths, (2) higher recoveries, or greater degree of cesium removal, than is readily achieved by precipitation technology, and (3) a choice of either continuous or batch operation. Specifically, this paper describes the extraction of cesium by dipicrylamine using nitrobenzene for the organic diluent. Synthetic Purex waste streams as well as actual Purex wastes were tested. 27 refs., 11 figs., 10 tabs.

12503 (IAEA-TECDOC–580, pp. 71-76) **Spent fuel and waste management in Czechoslovakia.** Petenyi, V. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)); Vandlikova, M.; Belko, D. International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

Electricity production based on the nuclear source was started in Czechoslovakia on industrial scale in 1979 when the first PWR-unit of the WWER-440 type was put into operation at the Nuclear Power Plants, Jaslovske Bohunice. At present, eight units of this type are operational with total capacity of about 3500 MWe and they supply about 25% of electricity production. In accordance with the mutual agreement between the Soviet Union and Czechoslovakia, the spent fuel after five year cooling period is transported to the Soviet Union. The operational radioactive waste (including reactor and storage facilities) is conditioned at the power plant sites and after then transported to the regional repositories. (author). 5 refs.

12504 (IAEA-TECDOC–580, pp. 85-93) **LWR spent fuel management in the Federal Republic of Germany.** International Atomic Energy Agency, Vienna (Austria); Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.). Dec 1990.

(CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The spent fuel management strategy in the Federal Republic of Germany is based on interim storage and subsequent reprocessing of spent fuel. The waste will be disposed of in a geological repository. In parallel, alternative back-end fuel cycle techniques such as the direct disposal of spent fuel without reprocessing are being tested in a pilot plant and might at a later date be used for disposal of spent fuel which is not suitable for reprocessing. (author).

12505 (IAEA-TECDOC–580, pp. 39-41) **Spent fuel management in Argentina.** Araoz, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Devcic, N.; Giambiagi, S. International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The general program on Argentinian Spent Fuel Management has been informed in previous meetings and IAEA publications. This presentation includes an updating of the programs and a short description of the dry storage of Embalse NPP spent fuel. (author).

12506 (IAEA-TECDOC–580, pp. 43-69) **Spent fuel management in Canada: Current developments and future plans.** Naqvi, S.J. (Ontario Hydro, Toronto, ON (Canada). Used Fuel Management and Decommissioning Unit). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The current developments and future plans in the Canadian Spent Fuel Management Program are discussed. Two storage strategies are being developed in Canada: (i) interim storage for the near-term of about 50 years, and (ii) extended storage for a longer term if required in the future. These are discussed in the context of Canadian spent fuel arisings and the timing of long-term plans. Spent fuel transportation systems are under development for road, rail and barge modes of transportation. Three decades of Canadian research in fuel cycles, which include the slightly enriched uranium cycle, U/Pu and Thorium/U-233 cycles is discussed. These could be sequenced into the current once-through cycle, if needed. The status of research into the long term behaviour of spent fuel and the national program for the disposal of spent fuel are reviewed. An integrated approach to spent fuel management using a Concrete Integrated Container (CIC) as a multi-purpose container for storage, transportation and possibly disposal, now being developed in Canada, is also reviewed. (author). 45 refs, 7 figs, 10 tabs.

12507 (IAEA-TECDOC–580, pp. 7-11) **IAEA spent fuel management programme - past and present.** Sokolov, F. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle and Waste Management). International Atomic Energy Agency, Vienna (Austria). Dec 1990. (CONF-9003243–: Advisory group meeting on spent fuel management: current status and prospects, Vienna (Austria), 19-22 Mar 1990). In *Spent fuel management: Current status and prospects 1990: Proceedings of the regular advisory group meeting, held in Vienna, 19-22 March 1990.* 173p. Order Number DE91622710. Source: OSTI; NTIS (US Sales Only); INIS.

The main effort in the area of IAEA spent fuel program has been concentrated on safety, economics, technical and environmental aspects of spent fuel storage and strategy of spent fuel management. Investments, operation and other related costs of spent fuel storage both wet and dry have been evaluated. International studies on feasibility of the separation and utilization of noble metals from high level waste, behaviour of spent fuel assemblies under extended storage, reliability of structural materials in the back-end of the nuclear fuel cycle etc. aiming at providing a well balanced basis for concrete solutions on a national level were performed. The Technical Co-operation Project MEX 9/035/1 on Spent Fuel Management between the Mexican Government and the IAEA and the Coordinated Research Programme (CRP) on Behaviour of Spent Fuel and Storage Facilities Components During Long-Term Storage (BEFAST-II) are in progress. In the next decade the main emphasis will be put on: spent fuel storage, international safety standards for the safe long-term storage of spent fuel, a guide covering special criteria and data base for a well-grounded choice between ultimate storage or reprocessing of spent fuel, a spent fuel management data base on spent fuel arisings, storage, safety, transportation, etc., reliability of structural materials for spent fuel transportation/storage casks, handling and storage facilities, treatment and MOX fuel fabrication plants, utilization of some valuable elements contained in spent fuel, detailed aspects of management with severely damaged nuclear fuel, etc.

12508 (KFK–4800) **Conditioning of radioactive waste solutions by cementation.** Vejmelka, P.; Rudolph, G.; Kluger, W.; Koester, R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik. Dec 1990. 88p. (In German). Order Number DE91759550. Source: OSTI; NTIS (US Sales Only); INIS.

For the cementation of the low and intermediate level evaporator concentrates resulting from reprocessing experiments were performed to optimize the waste form composition and to characterize the final waste form. Properties of the waste/cement suspension were investigated. These investigations include the dependence of viscosity, bleeding, setting time and hydration heat from the waste cement slurry composition. The results indicate that from process requirements portland cements give the best mixtures for the cementation. For comparable compositions mixtures with portland cement have a lower tendency to bleed and a lower viscosity than mixtures with blast furnace slag cement or pozzolanic cement. In contrast to the better workability the output of hydration heat is higher but this has no negative effect on the cementation process. For the characterization of the waste forms, the mechanical, thermal and chemical stability were determined. For special cases detailed investigations were performed to determine the activity release from waste packages under defined mechanical and thermal stresses. The investigations of the interaction of the waste forms with aqueous solutions include the determination of the Cs/Sr release, the corrosion resistance and the release of actinides. The Cs/Sr release was determined in dependence of the cement type, additives, setting time and sample size. The corrosion resistance in Q brine was determined as a function of the sample composition. For the determination of the corrosion mechanism, samples with selected composition were used. In order to assess the long term activity release of the long lived actinides, the equilibrium concentrations of U, Np, Pu and Am were determined on the basis of a thermodynamical equilibrium concept. (orig./HP).

12509 (LA–11594-MS) **Evaluation of dust-related health hazards associated with air coring at G-Tunnel, Nevada Test Site.** Skaggs, B.J.; Ortiz, L.W.; Burton, D.J.; Isom, B.L.; Vigil, E.A. Los Alamos National Lab., NM (USA). Mar 1991. 110p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91008161. Source: OSTI; NTIS; INIS; GPO Dep.

The Yucca Mountain Project was established to evaluate the potential for storing high-level radioactive wastes in geologic formations. Hydrologists recommended that drilling or coring in support of characterization tests be performed dry. Dry drilling, or air coring, presents a concern about health protection for the drilling personnel. The rock generally has a high silica content, and natural zeolites are abundant. Some zeolites are fibrous, leading to concerns that inhalation may result in asbestos-like lung diseases. An industrial hygiene study (IH) was conducted as part of an air coring technical feasibility test. The IH study found the potential for exposures to airborne silica and nuisance dusts to be within regulatory requirements and determined the commercial dust control equipment monitored to be effective when used in conjunction with a

good area ventilation system and sound IH practices. Fibrous zeolites were not detected. Recommendations for the Yucca Mountain studies are (1) dust collection and control equipment equivalent or superior to that monitored must be used for any dry drilling activity and must be used with good general dilution ventilation and local exhaust ventilation provided on major emission sources; (2) good industrial hygiene work practices must be implemented, including monitoring any area where zeolitic fibers are suspect; and (3) a study should be conducted to determine the biological effects of the fibrous zeolite, mordenite. 25 refs., 17 figs., 14 tabs.

12510 (LBL–29682) **Advances in the study of far-field phenomena affecting repository performance.** Tsang, C.F. Lawrence Berkeley Lab., CA (USA). Jan 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-910435–55: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91009332. Source: OSTI; NTIS; INIS; GPO Dep.

Studies of far-field phenomena affecting repository performance have focussed on the role of fractures and other heterogeneities in the potential transport of radioactive solutes from the repository to the biosphere. The present paper summarizes two recent advances in the subject: the channeling model for the understanding and analysis tracer transport in variable-aperture fractures and the modeling of coupled thermo-hydro-mechanical processes in geologic formation around a repository. The paper concludes with remarks on the need for duality in the approach to performance assessment. One line of the duality is fundamental studies and the other, goal-oriented assessment to satisfy regulatory requirements. 15 refs., 10 figs., 1 tab.

12511 (LBL–29703) **Geological problems in radioactive waste isolation: A world wide review.** Witherspoon, P.A. (ed.). Lawrence Berkeley Lab., CA (USA). Jan 1991. 236p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-8907218–: Workshop on geological problems in radioactive waste isolation - a worldwide review, Washington, DC (USA), 15-16 Jul 1989). Order Number DE91008919. Source: OSTI; NTIS; INIS; GPO Dep.

The problem of isolating radioactive wastes from the biosphere presents specialists in the fields of earth sciences with some of the most complicated problems they have ever encountered. This is especially true for high level waste (HLW) which must be isolated in the underground and away from the biosphere for thousands of years. Essentially every country that is generating electricity in nuclear power plants is faced with the problem of isolating the radioactive wastes that are produced. The general consensus is that this can be accomplished by selecting an appropriate geologic setting and carefully designing the rock repository. Much new technology is being developed to solve the problems that have been raised and there is a continuing need to publish the results of new developments for the benefit of all concerned. The 28th International Geologic Congress that was held July 9–19, 1989 in Washington, DC provided an opportunity for earth scientists to gather for detailed discussions on these problems. Workshop W3B on the subject, "Geological Problems in Radioactive Waste Isolation – A World Wide Review" was organized by Paul A Witherspoon and Ghislain de Marsily and convened July 15–16, 1989 Reports from 19 countries have been gathered for this publication. Individual papers have been cataloged separately.

12512 (LBL–29867) **Radionuclides in hydrothermal systems as indicators of repository conditions.** Wollenberg, H.A.; Flexser, S.; Smith, A.R. Lawrence Berkeley Lab., CA (USA). Nov 1990. 11p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-901105–108: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91009096. Source: OSTI; NTIS; INIS; GPO Dep.

Hydrothermal systems in tuffaceous and older sedimentary rocks contain evidence of the interaction of radionuclides in fluids with rock matrix minerals and with materials lining fractures, in settings somewhat analogous to the candidate repository site at Yucca Mountain, NV. Earlier studies encompassed the occurrences of U and Th in a "fossil" hydrothermal system in tuffaceous rock of the San Juan Mountains volcanic field, CO. More recent and ongoing studies examine active hydrothermal systems in calderas at Long Valley, CA and Valles, NM. At the Nevada Test Site, occurrences of U and Th in fractured and unfractured rhyolitic tuff that was heated to simulate the introduction of radioactive waste are also under investigation. Observations to date suggest that U is mobile in hydrothermal systems, but that localized reducing environments provided by Fe-rich minerals and/or carbonaceous material concentrate U and thus attenuate its migration. 11 refs., 6 figs., 1 tab.

12513 (LBL–30146) **Method development and strategy for the characterization of complexly faulted and fractured rhyolitic tuffs, Yucca Mountain, Nevada, USA.** Karasaki, K. (Lawrence Berkeley Lab., CA (USA)); Galloway, D. Lawrence Berkeley Lab., CA (USA). Oct 1990. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9010214–2: NEA workshop on flow heterogeneity and site evaluation, Paris (France), 22-24 Oct 1990). Order Number DE91009092. Source: OSTI; NTIS; INIS; GPO Dep.

Field experimental and analytical methods development is underway to define the hydraulic and transport properties of a thick saturated zone that underlies the planned high-level nuclear waste repository at Yucca Mountain, Nevada. The characterization strategy for the highly heterogeneous hydrology is that of hypothesis testing and confidence building. Three test wells, the UE-25c-holes, have been drilled and preliminary data have been collected. Hydro-mechanical analyses indicate formation fluid at depth is hydraulically connected to the water table. Preliminary hydraulic tests indicate highly localized, fracture-controlled transmissivity. Cross-hole seismic tomography is planned to assess the inter-borehole structure of fractures and faults. Multi-level cross-hole hydraulic interference and tracer tests are planned using up to 5 packed-off zones in each of the c-holes to assess the hydraulic conductivity and transport structure in a crude tomographic fashion. An equivalent discontinuum model conditioned with the observed hydraulic measurements will be applied to interpret the hydraulic test responses. As an approach to the scale problem the tests will be designed and analyzed to examine the hypothesis that the flow system may be represented by fractal geometry. 12 refs., 4 figs.

12514 (LBL–30181) **Lubrication theory analysis of the permeability of rough-walled fractures.** Zimmerman, R.W.; Kumar, S.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (USA). Jan 1991. 29p. Sponsored by USDOE, Washington, DC (USA); Geological Survey, Reston, VA (USA). DOE Contract AC03-76SF00098. (CONF-910435–54: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91009080. Source: OSTI; NTIS; INIS; GPO Dep.

The flow of a fluid between the rough surfaces of a rock fracture is very complex, due to the tortuous paths followed by the fluid particles. Exact analytical modeling of these flows is made difficult by the irregular geometry of rock fracture surfaces, while full three-dimensional numerical simulations of these flows are as yet still impractical. To overcome the difficulties of working with the three-dimensional Navier-Stokes equations, the simpler Reynolds lubrication equation has sometimes been used to model flow in fractures. This paper focuses on two aspects of lubrication theory. First, lubrication theory is applied to two simplified aperture profiles, sinusoidal and sawtooth, and analytical expressions are found for the permeabilities. These results are then compared with numerical results obtained by solving the lubrication equation for fractures with random surfaces. Secondly, the validity of the lubrication equations for modeling flow in rough fractures is studied by examining higher-order perturbation solutions, as well as numerical solutions, to the Navier-Stokes equations for flow in fractures with sinusoidally-varying apertures. 22 refs., 6 figs.

12515 (NUREG/CR–4295) **Bond strength of cementitious borehole plugs in welded tuff.** Akgun, H. (Arizona Univ., Tucson, AZ (USA). Dept. of Mining and Geological Engineering); Daemen, J.J.K. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Arizona Univ., Tucson, AZ (USA). Dept. of Mining and Geological Engineering. Feb 1991. 310p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; GPO; INIS.

Axial loads on plugs or seals in an underground repository due to gas, water pressures and temperature changes induced subsequent to waste and plug emplacement lead to shear stresses at the plug/rock contact. Therefore, the bond between the plug and rock is a critical element for the design and effectiveness of plugs in boreholes, shafts or tunnels. This study includes a systematic investigation of the bond strength of cementitious borehole plugs in welded tuff. Analytical and numerical analysis of borehole plug-rock stress transfer mechanics is performed. The interface strength and deformation are studied as a function of Young's modulus ratio of plug and rock, plug length and rock cylinder outside-to-inside radius ratio. The tensile stresses in and near an axially loaded plug are analyzed. The frictional interface strength of an axially loaded borehole plug, the effect of axial stress and lateral external stress, and thermal effects are also analyzed. Implications for plug design are discussed. The main conclusion is a strong recommendation to design friction plugs in shafts, drifts, tunnels or boreholes with a minimum length to diameter ratio of four. Such a geometrical design will reduce tensile stresses in the plug and in the host rock to a level which should minimize the risk of long-term deterioration caused by excessive tensile stresses. Push-out tests have been used to determine the bond strength by applying an axial load to cement plugs emplaced in boreholes in welded tuff cylinders. A total of 130 push-out tests have been performed as a function of borehole size, plug length, temperature, and degree of saturation of the host tuff. The use of four different borehole radii enables evaluation of size effects. 119 refs., 42 figs., 20 tabs.

12516 (NUREG/CR–4670) **Radionuclide distributions and migration mechanisms at shallow land burial sites: Final report of PNL research investigations on the distribution, migration, and containment of radionuclides at Maxey Flats, Kentucky.** Kirby, L.J.; Toste, A.P.; Thomas, C.W.; Rickard, W.H.; Nielson, H.L.; Campbell, R.M.; McShane, M.C.; Wilkerson, C.L.; Robertson, D.E. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 90p. Sponsored by Nuc. DOE Contract AC06-76RL01830. Source: OSTI; NTIS; INIS; GPO.

During the past several years, Pacific Northwest Laboratory (PNL) has conducted research at the Maxey Flats Disposal Site (MFDS) for the US Nuclear Regulatory Commission (NRC). This work has identified the spectrum of radionuclides present in the waste trenches, determined the processes that were occurring relative to degradation of radioactive material within the burial trenches, determined the chemical and physical characteristics of the trench leachates and the chemical forms of the leached radionuclides, determined the mobility of these radionuclides, investigated the subsurface and surface transport processes, determined the biological uptake by the native vegetation, developed strategies for environmental monitoring, and investigated other factors that influence the long-term fate of the radionuclide inventory at the disposal site. This report is a final summary of the research conducted by PNL and presents the results and discussions relative to the above investigative areas. 45 refs., 31 figs., 17 tabs.

12517 (NUREG/CR–5432-Vol.1) **Recommendations to the NRC for soil cover systems over uranium mill tailings and low-level radioactive wastes: Identification and ranking of soils for disposal facility covers: Volume 1.** Bennnett, R.D. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Feb 1991. 54p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The US Army Engineer Waterways Experiment Station (WES) has provided recommendations to the US Nuclear Regulatory Commission (NRC) for the selection, placement, compaction, testing, and acceptance of soils proposed to be placed in cover systems over uranium mill tailings and low-level radioactive wastes. The recommendations from WES are contained in three volumes of NUREG/CR-5432. Volume 1 identifies the various soil types and engineering properties that are needed to fulfill important soil cover functions. The identified soils are then ranked according to their capability to perform the low-permeability and filter and drainage functions. Volume 2 provides recommendations for conducting pertinent laboratory and field tests to ensure acceptable soil cover performance. Volume 3 covers recommendations from WES on proper field construction methods including guidance on quality control testing and inspections. Recommendations are given for sealing penetrations (e.g., observation wells) that are required to penetrate covers for environmental monitoring of disposal facility performance. 54 refs., 15 figs., 9 tabs.

12518 (NUREG/CR–5432-Vol.2) **Recommendations to the NRC for soil cover systems over uranium mill tailings and low-level radioactive wastes: Laboratory and field tests for soil covers: Volume 2.** Bennett, R.D. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)); Horz, R.C. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Feb 1991. 73p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The US Army Engineer Waterways Experiment Station (WES) has provided recommendations to the US Nuclear Regulatory Commission (NRC) for the selection, placement, compaction, testing, and acceptance of soils proposed to be placed in cover systems over uranium mill tailings and low-level radioactive wastes. The recommendations from WES are contained in three volumes of NUREG/CR-5432. Volume 1 identifies the various soil types and engineering properties that are needed to fulfill important soil cover functions. The identified soils are than ranked according to their capability to perform the low-permeability and filter and drainage functions. Volume 2 provides recommendations for conducting pertinent laboratory and field tests to ensure acceptable soil cover performance. Volume 3 covers recommendations from WES on proper field construction methods including guidance on quality control testing and inspections. Recommendations are given for sealing penetrations (e.g., observation wells) that are required to penetrate covers for environmental monitoring of disposal facility performance. 31 refs., 2 figs., 2 tabs.

12519 (NUREG/CR–5432-Vol.3) **Recommendations to the NRC for soil cover systems over uranium mill tailings and low-level radioactive wastes: Construction methods and guidance for sealing penetrations in soil covers: Volume 3.** Bennett, R.D. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)); Kimbrell, A.F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Feb 1991. 79p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The US Army Engineer Waterways Experiment Station (WES) has provided recommendations to the US Nuclear Regulatory Commission (NRC) for the selection placement, compaction, testing, and acceptance of soils proposed to be placed in cover systems over uranium mill tailings and low-level radioactive wastes. The recommendations from WES are contained in three volumes of NUREG/CR-5432. Volume 1 identifies the various soil types and engineering properties that are needed to fulfill important soil cover functions. The identified soils are then ranked according to their capability to perform the low-permeability and filter and drainage functions. Volume 2 provides recommendations for conducting pertinent laboratory and field tests to ensure acceptable soil cover performance. Volume 3 covers recommendations from WES on proper field construction methods including guidance on quality control testing and inspections. Recommendations are given for sealing penetrations (e.g., observation wells) that are required to penetrate covers for environmental monitoring of disposal facility performance. 30 refs., 6 figs., 9 tabs.

12520 (NUREG/CR–5618) **User's manual for the NEFTRAN II computer code.** Olague, N.E. (Sandia National Labs., Albuquerque, NM (USA)); Campbell, J.E.; Leigh, C.D.; Longsine, D.E. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 248p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (SAND–90-2089). Source: OSTI; NTIS; INIS; GPO.

This document describes the NEFTRAN II (NEtwork Flow and TRANsport in Time-Dependent Velocity Fields) computer code and is intended to provide the reader with sufficient information to use the code. NEFTRAN II was developed as part of a performance assessment methodology for storage of high-level nuclear waste in unsaturated, welded tuff. NEFTRAN II is a successor to the NEFTRAN and NWFT/DVM computer codes and contains several new capabilities. These capabilities include: (1) the ability to input pore velocities directly to the transport model and bypass the network fluid flow model, (2) the ability to transport radionuclides in time-dependent velocity fields, (3) the ability to account for the effect of time-dependent saturation changes on the retardation factor, and (4) the ability to account for time-dependent flow rates through the source regime. In addition to these changes, the input to NEFTRAN II has been modified to be more convenient for the user. This document is divided into four main sections consisting of (1) a description of all the models contained in the code, (2) a description of the program and subprograms in the code, (3) a data input guide and (4) verification and sample problems. Although NEFTRAN II is the fourth generation code, this document is a complete description of the code and reference to past user's manuals should not be necessary. 19 refs., 33 figs., 25 tabs.

12521 (NUREG/CR–5672-Vol.1) **Characteristics of low-level radioactive waste: Decontamination waste: Annual report for Fiscal Year 1990.** McIsaac, C.V. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Akers, D.W. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1991. 30p. Sponsored by Nuc. DOE Contract AC07-76ID01570. (EGG–2635-Vol.1). Source: OSTI; NTIS; INIS; GPO.

The objective of Project FIN A6359, "Characteristics of Low-Level Radioactive Waste: Decontamination Waste Forms," funded by the US Nuclear Regulatory Commission, is to provide base-line data on the stability and leachability of solidified decontamination wastes that are generated at operating commercial nuclear power stations following the chemical decontamination of primary coolant systems. This work is being performed to assess the adequacy of tests identified in "Technical Position on Waste Forms," prepared by the NRC Low-Level Waste Management Branch, to meet the requirements of 10 CFR 61. As part of the project, samples of decontamination waste stream resins and cement waste forms were obtained from commercial nuclear power stations. During Fiscal Year 1990, samples from the FitzPatrick and Brunswick nuclear stations were examined. Samples were subjected to the leach tests described in "Technical Position on Waste Forms" to assess the effects of the decontamination wastes on the stability and leachability of the waste forms. Demineralized water and four different synthetic leachates with pH ranging from 4.2 to 10.4 were used for the tests. The results of these tests are tabulated and preliminary analyses are presented. In addition, samples from the Peach Bottom nuclear station were acquired for examination during Fiscal Year 1991. 1 ref., 21 tabs.

12522 (ORNL/M–1179) **Active Sites Environmental Monitoring Program: Mid-FY 1990 summary report.** Wickliff, D.S.; Morrissey, C.M.; Ashwood, T.L. Oak Ridge National Lab., TN (USA). Feb 1991. 26p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008818. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication No. 3504.

Surface runoff, groundwater, and soil monitoring data continue to demonstrate that radioactive materials disposed of on the Tumulus I pad are not leaching into the environment. The pH of the runoff from the Tumulus I pad frequently exceeds the upper limit (9.0) established in the permit for the facility. Recent measurements show that the pH of the runoff from the newly constructed Tumulus II pad approaches this upper limit. Tritium activity has reached a level of ~6000 Bq/L in Tumulus I Well 1036 and a level of ~500 Bq/L in Tumulus I Well 1039. The likely source of tritium has been identified as along-strike transport from another area of Solid Waste Storage Area (SWSA) 6. Solid Waste Operations personnel have taken corrective action that should reduce tritium levels, but is likely to be at least a year before any reduction is apparent. Samples from eight intratrench wells adjacent to active low level waste silos have not shown radionuclide activity levels above background. Approximately 45 more wells will be installed adjacent to silos, auger holes, and fissile wells during May and June. Groundwater samples and groundwater elevation measurements suggest that transuranic elements are being leached from casks buried in trenches in the southwest corner of SWSA 5 North. Water levels measured in the vicinity of storage facilities 7827 and 7829 also suggest that more deeply stored materials in these facilities may be below the water table. However, groundwater samples taken some distance down-gradient do not contain elevated levels of radioactivity. Environmental Sciences Division personnel will provide recommendations to Solid Waste Operations concerning means of more closely monitoring the groundwater around facilities 7827 and 7829. 3 refs., 12 figs., 8 tabs.

12523 (PNL–7599) **Minutes of the Tank Waste Science Panel meeting September 13–14, 1990: Hanford Tank Safety Project.** Strachan, D.M.; Morgan, L.G. (comps.). Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 55p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009186. Source: OSTI; NTIS; INIS; GPO Dep.

The third meeting of the Tank Waste Science Panel was held September 13–14, 1990. Science Panel members were briefed on the August 5, 1990, gas release from tank 241-101-SY (commonly denoted 101-SY), synthetic waste experiments to investigate gas generation and crust behavior in the tank, computer simulations of the thermal behavior of the waste in the tank, and calculations of gas generation based on radiolytic chemistry in alkaline solutions. Data from tanks 103-SY and 103-AN were presented, but it was decided not to divert attention from tank 101-SY at this time by taking additional samples from 103-SY or 103-AN. Science Panel members recommended that multiple groups begin a concerted experimental effort to understand the chemical and physical mechanisms involved in the tank. The understanding, along with the tank model, can then be used to determine the effectiveness of a particular mitigation method before using the method in tank 101-SY. 1 tab.

12524 (PNL–7602) **Minutes of the tank waste science panel meeting, June 26-27, 1990.** Strachan, D.M.; Morgan, L.G. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 39p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009103. Source: OSTI; NTIS; GPO Dep.

Members of the Tank Waste Science Panel met June 26–27, 1990, to discuss physical and chemical processes that could be responsible for episodic gas release events in tank 241-101-SY (commonly denoted tank 101-SY). Historical information regarding safety issues of tank 101-SY was presented along with existing technical information. Science Panel members agreed that the temperature profile just prior to a gas release suggests that either the high solids content or the density in the bottom layer of waste tends to trap gases generated in this layer until buoyancy forces cause the gas to begin moving. The crust is thought to provide only minimal resistance for the passage of the gas released from the bottom of the tank. Insufficient data were available to endorse any suggested mechanism for chemical evolution of H_2 in the tank. Science Panel members made numerous recommendations for monitoring the tank, sampling gases in the tank vent, taking core samples, and performing analyses. They also recommended performance of experiments to develop a fundamental understanding of the chemical processes involved and to determine the source of the H_2 and N_2O gases. 3 refs.

12525 (PNL-SA–18592) **Incorporating regulatory considerations into waste treatment technology development.** Siegel, M.R.; Powell, J.A.; Williams, T.A.; Kuusinen, T.L.; Lesperance, A.M. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-910270–22: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008747. Source: OSTI; NTIS; INIS; GPO Dep.

It is generally recognized that the development of new and innovative waste treatment technologies can significantly benefit the US Department of Energy's (DOE) environmental restoration and waste management program. DOE has established a research, development, demonstration, testing, and evaluation (RDDT&E)

program, managed by its Office of Technology Development, to encourage and direct the development of new waste treatment and management technologies. The treatment, storage, and disposal of hazardous and radioactive waste is heavily regulated both at the federal and state levels. In order to achieve the goals of applying the best new technologies in the fastest and most cost-effective manner possible, it is essential that regulatory factors be considered early and often during the development process. This paper presents a number of regulatory issues that are relevant to any program intended to encourage the development of new waste treatment and management technologies. It will also address how the use of these basic regulatory considerations can help ensure that technologies that are developed are acceptable to regulators and can therefore be deployed in the field. 2 refs.

12526 (PNL-SA–18628) **Alternatives for treatment, storage and disposal of Greater-Than-Class C Low-Level Waste at West Valley, New York.** Ross, W.A.; Janke, D.S. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 12p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910270–23: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008743. Source: OSTI; NTIS; INIS; GPO Dep.

The West Valley Demonstration Project has generated and will continue to generate commercial Greater-Than-Class C Low-Level Waste from both vitrification operations and decommissioning operations. This paper summarizes information on the quantity of wastes, and describes alternatives for interim storage, treatment, and disposal. Waste management systems comprised of treatment, storage, and disposal options are identified, and the first order economics associated with the systems are evaluated. 5 refs., 2 tabs.

12527 (PNL-SA–18980) **Regulatory barriers to hazardous waste technology innovation.** Kuusinen, T.L.; Siegel, M.R. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 9p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910270–21: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008744. Source: OSTI; NTIS; INIS; GPO Dep.

The primary federal regulatory programs that influence the development of new technology for hazardous waste are the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also commonly known as Superfund). Two important aspects of RCRA that can create barriers to hazardous waste technology innovation are technology-based waste pre-treatment standards and a cumbersome permitting program. By choosing a technology-based approach to the RCRA land disposal restrictions program, the US Environmental Protection Agency (EPA) has simultaneously created tremendous demand for the technologies specified in its regulations, while at the same time significantly reduced incentives for technology innovation that might have otherwise existed. Also, the RCRA hazardous waste permitting process can take years and cost hundreds of thousands of dollars. The natural tendency of permit writers to be cautious of unproven (i.e., innovative) technology also can create a barrier to deployment of new technologies. EPA has created several permitting innovations, however, to attempt to mitigate this latter barrier. Understanding the constraints of these permitting innovations can be important to the success of hazardous waste technology development programs. 3 refs.

12528 (POEF-T–3537) **Demonstration of the viability of performing "quick check" surveys for uranium in 5-inch cans and 55-gallon drums for nuclear criticality safety.** Taylor, R.W. Jr. (Battelle, Columbus, OH (USA)). Portsmouth Gaseous Diffusion Plant, OH (USA). 11 Dec 1990. 12p. Sponsored by USDOE,. DOE Contract AC05-76OR00001. Order Number DE91007465. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the experimental work performed to demonstrate the viability of performing a "quick check" survey with available gamma radiation instruments. The surveys are performed as a supplement to visual inspection of wastes prior to, and during, batching of wastes from favorable geometry 5-inch cans into unfavorable geometry 55-gallon drums to preclude a nuclear criticality accident. As little as 10 grams of U^{235} in a 5-inch can and 150 grams of U^{235} in a 55-gallon drum filled with low density wastes (cloth or paper) are easily detectable. 2 refs., 4 figs., 5 tabs.

12529 (SAND–89-7006-Vol.1) **MRS system study for the repository: Yucca Mountain Site Characterization Project: Volume 1.** Sinagra, T.A. (Bechtel National, Inc., San Francisco, CA (USA)); Harig, R. Sandia National Labs., Albuquerque, NM (USA); Bechtel National, Inc., San Francisco, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA). Dec 1990. 267p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91008314. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), has initiated a waste management system study to identify the impacts of the presence or absence of a monitored retrievable storage facility (hereinafter referred to as "MRS") on system costs and program schedules. To support this study, life-cycle cost estimates and construction schedules have been prepared for the surface and underground facilities and operations of a geologic nuclear waste repository at Yucca Mountain, Nye County, Nevada. Nine different operating scenarios (cases) have been identified by OCRWM for inclusion in this study. For each case, the following items are determined: the repository design and construction costs, operating costs, closure and decommissioning costs, required staffing, construction schedules, uncertainties associated with the costs and schedules, and shipping cask and disposal container throughputs. 6 refs., 83 figs., 57 tabs.

12530 (SAND–89-7006-Vol.2) **MRS system study for the repository: Yucca Mountain Site Characterization Project: Volume 2.** Sinagra, T.A. (Bechtel National, Inc., San Francisco, CA (USA)); Harig, R. Sandia National Labs., Albuquerque, NM (USA); Bechtel National, Inc., San Francisco, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA). Dec 1990. 531p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91008315. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), has initiated a waste management system study to identify the impacts of the presence or absence of a monitored retrievable storage facility (hereinafter referred to as "MRS") on system costs and program schedules. To support this study, life-cycle cost estimates and construction schedules have been prepared for the surface and underground facilities and operations geologic nuclear waste repository at Yucca Mountain, Nye County, Nevada. Nine different operating scenarios (cases) have been identified by OCRWM for inclusion in this study. For each case, the following items are determined: the repository design and construction costs, operating costs, closure and decommissioning costs, required staffing, construction schedules, uncertainties associated with the costs and schedules, and shipping cask and disposal container throughputs. This document contains A-D.

12531 (SAND–90-2342C) **A first approximation for modeling the liquid diffusion pathway at the greater confinement disposal facilities.** Olague, N.E.; Price, L.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 18p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910270–7: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91007570. Source: OSTI; NTIS; INIS; GPO Dep.

The greater confinement disposal (GCD) project is an ongoing project examining the disposal of orphan wastes in Area 5 of the Nevada Test Site. One of the major tasks for the project is performance assessment. With regard to performance assessment, a preliminary conceptual model for ground-water flow and radionuclide transport to the accessible environment at the GCD facilities has been developed. One of the transport pathways that has been postulated is diffusion of radionuclides in the liquid phase upward to the land surface. This pathway is not usually considered in a performance assessment, but is included in the GCD conceptual model because of relatively low recharge estimates at the GCD site and the proximity of the waste to the land surface. These low recharge estimates indicate that convective flow downward to the water table may be negligible; thus, diffusion upward to the land surface may then become important. As part of a preliminary performance assessment which considered a basecase scenario and a climate-change scenario, a first approximation for modeling the

liquid-diffusion pathway was formulated. The model includes an analytical solution that incorporates both diffusion and radioactivity decay. Overall, these results indicate that, despite the configuration of the GCD facilities that establishes the need for considering the liquid-diffusion pathway, the GCD disposal concept appears to be a technically feasible method for disposing of orphan wastes. Future analyses will consist of investigating the underlying assumptions of the liquid-diffusion model, refining the model is necessary, and reducing uncertainty in the input parameters. 11 refs., 6 figs.

12532 (SAND–90-2817C) **Experiment and analysis comparison in support of the Yucca Mountain Project.** Chen, E.P.; Bauer, S.J.; Costin, L.S.; Hansen, F.D. Sandia National Labs., Albuquerque, NM (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105103–1: International conference of the International Association for Computer Methods and Advances in Geomechanics, Cairns (Australia), 6-10 May 1991). Order Number DE91005315. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories, as a participant in the Yucca Mountain Project, administered by the Nevada Operations Office of the US Department of Energy, is in the process of evaluating a proposed site for geologic disposal of high-level nuclear wastes in the volcanic tuffs at Yucca Mountain, Nevada. In a repository, loads will be imposed on the rock mass as a result of excavation of the openings and heating of the rock by the nuclear waste. In an attempt to gain a better understanding of the thermal, mechanical, and thermomechanical response of fractured tuff, a series of experiments have been performed, and measurements have been taken in the welded and nonwelded tuffs at the G-Tunnel underground test facility at Rainier Mesa, Nevada. Comparisons between measured and calculated data of the G-Tunnel High-Pressure Flatjack Development Experiment are presented in this investigation. Calculated results were obtained from two dimensional finite element analysis using a recently developed compliant-joint rock-mass model. The purpose of this work was to assess the predictive capability of the model based on limited material property data for the G-Tunnel welded tuff. The results of this evaluation are discussed.

12533 (SAND–90-2848) **The solubility of gases in NaCl brine and a critical evaluation of available data.** Cygan, R.T. Sandia National Labs., Albuquerque, NM (USA). 4 Jan 1991. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009185. Source: OSTI; NTIS; INIS; GPO Dep.

Knowledge of the solubility of gases in pure water and sodium chloride brine is required for the evaluation of gas-liquid behavior associated with numerous processes in the chemical, biological, and geological sciences and in chemical engineering. Modelling of multiphase flow and transport processes used to simulate fluid behavior in geological media requires suitable and accurate gas solubility data, especially when applied to potential nuclear waste repositories such as WIPP. This report contains a critical evaluation of data available in the literature and provides compiled data sets for the solubility of hydrogen, nitrogen, methane, and carbon dioxide gases in pure water and in sodium chloride brine. Mole fraction gas solubilities are presented as functions of temperature and pressure. To evaluate the influence of electrolyte content of the aqueous solution upon the gas solubility, Sechenov coefficients are provided for several concentrated sodium chloride solution. An estimate of the solubility of hydrogen in 5 N sodium chloride brine as a function of pressure exhibits a solubility at 40 MPa that is one fifth the value observed for pure water at the same pressure. 64 refs., 37 figs.

12534 (SAND–90-7009) **Consolidation, permeability, and strength of crushed salt/bentonite mixtures with application to the WIPP [Waste Isolation Pilot Plant].** Pfeifle, T.W. (RE/SPEC, Inc., Rapid City, SD (USA)). Sandia National Labs., Albuquerque, NM (USA); RE/SPEC, Inc., Rapid City, SD (USA). Jan 1991. 95p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Contract 23-8484. (RSI–0357). Order Number DE91007251. Source: OSTI; NTIS; INIS; GPO Dep.

Three tests were performed to measure the consolidation, permeability, and compressive strength of specimens prepared from bentonite/crushed salt mixtures. Each mixture comprised 30% bentonite and 70% crushed salt based on total dry weight. Brine was added to each mixture to adjust its water content to either 5 or 10% (nominal) of the total dry weight of the mixture. In the consolidation tests, each specimen was subjected to multiple stages of successively higher hydrostatic stress (pressure). During each stage, the pressure was maintained at a constant level and volumetric strain data were continuously logged. By using multiple stages, consolidation data were obtained at several pressures and the time required to consolidate the specimens to full saturation was reduced. Once full saturation was achieved, each specimen was subjected to a final test stage in which the hydrostatic stress was reduced and a permeability test performed. Permeability was measured using the steady flow of brine and was found to range between 1×10^{-17} and 5×10^{-17} m^2. After the final test stage, unconfined compressive strength was determined for each specimen and was found to range between 0.5 and 8.1 MPa. Two constitutive models were fitted to the consolidation data. One relatively simple model related volumetric strain to time while the other related instantaneous density to time, pressure, and initial density. 8 refs., 9 figs., 8 tabs.

12535 (SAND–91-0324C) **Prioritization of ES and H activities: A waste minimization example.** Kjeldgaard, E.A. (Sandia National Labs., Albuquerque, NM (USA)); Saloio, J.H.; Varnado, G.B. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910279–11: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991; TTC–1060). Order Number DE91009176. Source: OSTI; NTIS; GPO Dep.

This paper describes a formal process for selecting, from a diverse set of proposed waste minimization activities, those activities that provide the greatest benefit to DOE. A methodology for evaluating and prioritizing proposals was developed to illustrate how the selection process works and what types of data are required to characterize waste minimization activities. It is clearly impossible to remove all aspects of subjective judgment from the proposal selection process. With this important consideration in mind, the methodology presented is put forth to enhance, not replace, the traditional DOE decision-making process. With relatively minor refinements, this methodology can be immediately useful to DOE Environmental Restoration and Waste Management and Defense Program organizations in preparing, evaluating, and prioritizing waste minimization proposals. 7 refs., 1 tab., 2 figs.

12536 (UCRL–101323) **In-situ observation of the alpha/beta cristobalite transition using high voltage electron microscopy.** Meike, A. (Lawrence Berkeley Lab., CA (USA)); Glassley, W. Lawrence Livermore National Lab., CA (USA). Oct 1989. 11p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-891119–145: Materials Research Society fall meeting, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE91007613. Source: OSTI; NTIS; INIS; GPO Dep.

A high temperature water vapor phase is expected to persist in the vicinity of high level radioactive waste packages for several hundreds of years. The authors have begun an investigation of the structural and chemical effects of water on cristobalite because of its abundance in the near field environment. A high voltage transmission electron microscope (HVEM) investigation of bulk synthesized α-cristobalite to be used in single phase dissolution and precipitation kinetics experiments revealed the presence β-cristobalite, quartz and amorphous silica, in addition to α-cristobalite. Consequently, this apparent metastable persistence of β-cristobalite and amorphous silica during the synthesis of α-cristobalite was investigated using a heating stage and an environmental cell installed in the HVEM that allowed the introduction of either dry CO_2 or a CO_2 + H_2O vapor. Preliminary electron diffraction evidence suggests that the presence of water vapor affected the α-β transition temperature. Water vapor may also be responsible for the development of an amorphous silica phase at the transition that may persist over an interval of several tens of degrees. The amorphous phase was not documented during the dry heating experiments. 20 refs., 7 figs., 5 tabs.

12537 (UCRL-JC–106161) **Yucca Mountain Site Characterization Project Waste Package Plan.** Harrison-Giesler, D.J.

(USDOE Nevada Operations Office, Las Vegas, NV (USA). Yucca Mountain Project Office); Morissette, R.P.; Jardine, L.J. Lawrence Livermore National Lab., CA (USA). Feb 1991. 6p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910435–52: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91008733. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of the US Department of Energy's (DOE) Yucca Mountain Site Characterization Project (YMP) waste package program is to develop, confirm the effectiveness of, and document a design for a waste package and associated engineered barrier system (EBS) for spent nuclear fuel and solidified high-level nuclear waste (HLW) that meets the applicable regulatory requirements for a geologic repository. The Waste Package Plan describes the waste package program and establishes the technical approach against which overall progress can be measured. It provides guidance for execution and describes the essential elements of the program, including the objectives, technical plan, and management approach. The plan covers the time period up to the submission of a repository license application to the US Nuclear Regulatory Commission (NRC). 1 fig.

12538 (WHC-EP–0063-2) **Hanford Site radioactive solid waste acceptance criteria.** Willis, N.P. Westinghouse Hanford Co., Richland, WA (USA). Sep 1990. 166p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009164. Source: OSTI; NTIS; GPO Dep.

Westinghouse Hanford Company manages and operates the Hanford Site 200 Area radioactive solid waste treatment, storage, and disposal facilities for the US Department of Energy–Richland Operations Office. These facilities include radioactive solid waste disposal sites and radioactive solid waste storage areas. This manual defines the criteria that must be met by waste generators for radioactive solid waste to be accepted by Westinghouse Hanford Company for storage or disposal at the 200 Areas facilities. It is to be used by all waste generators preparing radioactive solid waste for storage or disposal at the Hanford Site facilities. This manual is also intended for use by Westinghouse Hanford Company solid waste technical staff involved with approval and acceptance of radioactive solid waste. The criteria in this manual represent a compilation of state and federal regulations; US Department of Energy orders; Hanford site requirements; and other rules, regulations, guidelines, and standards as they apply to management of radioactive solid waste. Where appropriate, these requirements are included in the manual by reference. It is the intent of this manual to provide guidance to the waste generator in meeting the applicable requirements. Chapters describe criteria for administrative procedures, transuranic wastes, low-level wastes, radioactive mixed waste storage and disposal. Chapters have been indexed separately for inclusion on the database.

12539 (WHC-EP–0182-28) **Tank farm surveillance and waste status summary report for Jul 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Nov 1990. 51p. Sponsored by USDOE,. DOE Contract AC06-87RL10930. Order Number DE91009161. Source: OSTI; NTIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive waste stored in the 200 Areas underground tanks at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 56 smaller catch tanks, and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 2 figs., 3 tabs.

12540 (WHC-EP–0182-29) **Tank farm surveillance and waste status summary report for August 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 55p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009159. Source: OSTI; NTIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 48 smaller catch tanks and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 2 figs., 5 tabs.

12541 (WHC-EP–0182-30) **Tank farm surveillance and waste status summary for September 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 62p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009347. Source: OSTI; NTIS; GPO Dep.

This is report Westinghouse Hanford Company's official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 48 smaller catch tanks and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 3 figs., 5 tabs.

12542 (WHC-EP–0182-31) **Tank farm surveillance and waste status summary for October 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 59p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009348. Source: OSTI; NTIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 48 smaller catch tanks and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 3 figs., 5 tabs.

12543 (WHC-EP–0182-32) **Tank farm surveillance and waste status summary report for November 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 61p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009349. Source: OSTI; NTIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory of radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations.

12544 (WHC-EP–0294) **Quality Assurance Program Plan for 200 Area single-shell tank characterization and assessment.** Board, D.C. Westinghouse Hanford Co., Richland, WA (USA). Nov 1990. 46p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009163. Source: OSTI; NTIS; GPO Dep.

This Quality Assurance Program Plan describes the general requirements for all tasks pertaining to the disposal, characterization, and assessment of all single-shell tank (SST) waste at US Department of Energy (DOE) Hanford Site. It identifies the action parties within Westinghouse Hanford Company (Westinghouse Hanford) and their roles and responsibilities, and provides traceability to the implementing plans and procedures. The interface and control of activities performed by other major site participants in the waste characterization and assessment process are also identified within this Quality Assurance Program Plan. This Quality Assurance Program Plan has five objectives: (1) Identify the Westinghouse Hanford organizations and major site participants involved in the SST waste disposal, characterization, and assessment work. (2) Identify the Westinghouse Hanford quality program criteria that apply in general and the format for meeting the EPA QAMS-005/80 specifications for environmental sampling, analysis, and reporting. (3) Identify and define the relationship between this Quality Assurance Program Plan and the work-specific Quality Assurance Project Plans that will be used to document planning at all levels.

(4) Provide information and guidance for decision making and actions that span more than one work-specific Quality Assurance Project Plan. The guidance and information is for use by those directly involved in planning and performing work. (5) Provide information for use by Westinghouse Hanford staff including the cognizant managers and the cognizant engineers who are responsible for the development and content of the Quality Assurance Project Plans. 17 refs., 3 figs.

12545 (WHC-EP–0365) **Annual report of tank waste treatability.** Karnesky, R.A. Westinghouse Hanford Co., Richland, WA (USA). Sep 1990. 151p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009162. Source: OSTI; NTIS; GPO Dep.

This report has been prepared as part of the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and constitutes completion of Tri-Party Agreement Milestone M-04-00. This report provides a summary of treatment activities for newly generated waste, existing double-shell tank (DST) waste, and existing single-shell tank (SST) waste. Existing waste in DSTs will be treated in B Plant to separate DST waste into high-level waste (HLW), transuranic (TRU) waste, and low-level waste (LLW) fractions. The HLW and TRU waste fractions will be vitrified in the Hanford Waste Vitrification Plant (HWVP) for permanent disposal in a national geologic repository. The LLW fraction will be treated in the Grout Treatment Facility (GTF) to make a solid waste form suitable for near-surface disposal in concrete vaults. The Tri-Party Agreement provides schedules for future HWVP and GTF activity. Existing waste in SSTs is being characterized to enable appropriate treatment options to be developed. This information is needed for a supplemental environmental impact statement (SEIS) leading to a decision on final SST waste disposal. Historical reviews of the process by which the grout waste form and the glass waste form were chosen are provided. A compilation of historical reports and abstracts is provided. 25 refs., 4 figs., 5 tabs.

12546 (WHC-SA–1000) **Permitting of the Hanford Waste Vitrification Plant.** LaRue, J.H. (Westinghouse Hanford Co., Richland, WA (USA)); Cross, S.L. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270–27: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009215. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Waste Vitrification Plant will be constructed to treat the high-level fraction of the radioactive liquid waste stored in tanks at the Hanford Site. Normal permitting practices under the Washington State Dangerous Waste Regulations require a facility to apply for and receive a final facility permit based on a completed design prior to the start of facility construction. However, the enormity and complexity of a project the size of the Hanford Waste Vitrification Plant dictates that construction begin before design is complete. An innovative permitting strategy has been developed to initiate timely construction of the Hanford Waste Vitrification Plant while providing the Washington State Department of Ecology with the necessary regulatory oversight. This strategy calls for a "multistage" permitting process, a process in which permits will be issued at various stages of facility design, construction, and operation. This process will also include Washington State Department of Ecology staff participation in the review of draft drawings and specifications, monthly meetings with the US Department of Energy, and onsite inspections. The concept of permitting the Hanford Waste Vitrification Plant at various stages in the design and construction process is a novel approach to the normal regulatory procedure of a single final permit. This approach will allow the Hanford Waste Vitrification Plant Project to stay on schedule while still maintaining the regulatory agency's oversight role. 6 refs., 5 figs.

12547 (WHC-SA–1120) **Waste Receiving and Processing (WRAP) Facility technology.** Scott, J.L. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270–34: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009420. Source: OSTI; NTIS; INIS; GPO Dep.

Waste treatment capabilities for Waste Receiving and Processing (WRAP) Facility Module 1 (WRAP-1) will be limited to opening and repackaging of suspect transuranic (TRU) drums and the necessary nondestructive examination (NDE) and nondestructive assay (NDA) services for shipment of the certified waste packages to the designated disposal facilities. The technologies used in WRAP Module 2 (WRAP-2) are principally those waste treatment methodologies necessary to ensure the final waste forms are in compliance with disposal and/or transportation criteria. The WRAP-2 will treat all TRU noncompliant waste items that do not meet the WIPP Waste Acceptance Criteria (WAC) segregated in WRAP-1, all the Hanford Site radioactive/hazardous low-level mixed waste (LLMW), all large items requiring size reduction/sorting/treatment needed for disposal (mostly large suspect TRU waste items), and remote-handled (high surface dose) waste items. The current scope of the WRAP-2 Facility will employ the following waste treatment technologies: passivation of the waste by chemical additives, waste immobilization (within grout matrixes), size reduction via shears/mechanical saws/plasma arc torches/lasers, compaction, shred/grouting, plasma melting, and wet chemical decontamination techniques. All waste materials will be certified to meet the appropriate US Department of Energy (DOE) orders for waste characterization and will adhere to the Resource Conservation and Recovery Act (RCRA) regulations in compliance with the promulgated treatment standards. 3 figs.

12548 (WHC-SA–1123) **Hanford Site transuranic waste container integrity.** Duncan, D.R.; Anderson, B.C.; Demiter, J.A. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270–32: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009313. Source: OSTI; NTIS; INIS; GPO Dep.

The transuranic waste containers stored in the retrievable storage units at the Hanford Site are described along with a description of their environment. The containers are of various types, predominantly steel 0.21-m^3 (55-gal) drums and boxes of many different sizes and materials. The storage environment is direct soil burial and storage in atmospheric conditions under plastic tarps with earth on top of the tarps. Available data from several transuranic waste storage sites are summarized and degradation rates are projected for containers in storage at the Hanford Site. 13 refs., 3 figs.

12549 (WINCO–1083) **Solute transport benchmark studies for TRACR3D code verification.** Thomas, T.R. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Feb 1991. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-84ID12435. Order Number DE91008918. Source: OSTI; NTIS; INIS; GPO Dep.

A three-dimensional code called TRACR3D, which is applicable to solute transport in both unsaturated and saturated media, is being used to model hypothetical transport of radioactive and nonradioactive constituents from calcined high-level radioactive waste (HLW) at the Idaho Chemical Processing Plant (ICPP). The modeling studies are part of a documentation process which will be required for evaluation of onsite disposal in a near-surface facility as a possible alternative strategy for the long-term management of ICPP HLW. This report discusses the results of a benchmark study for code verification. The problems modeled were: (1) A one-dimensional problem involving the transport of the pertechnetate ion (TcO_4^-) through a 5-cm diameter by 30-cm-long soil column at ICPP. (2) A one-dimensional problem involving the transport of the iodide ion (I^-) through a large caisson (3-m diameter by 6-m depth) at LANL. (3) A three-dimensional problem involving the transport of radioactive ruthenium (Ru-106) from a single-shell tank leak into the vadose zone at the Hanford site. For the three benchmark studies performed, it was concluded that the predicted results from TRACR3D were in agreement with documented and reported solute transport problems, that the input data files were properly configured, and that the code correctly performed the mathematical operations specified in the numerical models. These results will provide a greater degree of confidence in results obtained for planned modeling studies at ICPP. 6 refs., 8 figs., 2 tabs.

12550 (WSRC-MS–90-274) **Application of high level waste-glass technology to the volume reduction and immobilization of TRU, low level, and mixed wastes.** Bickford, D.F.; Smith,

M.E.; Allen, P.M.; Faraci, J.P.; Langton, C.A.; Wolf, K.Z. Westinghouse Savannah River Co., Aiken, SC (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-910270--28: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009319. Source: OSTI; NTIS; GPO Dep.

The EPA has designated vitrification as the "Best Developed Available Technology" for immobilization of high-level nuclear waste. Recent republic pronouncements and private conversations with the EPA indicate that the agency is considering long-term waste immobilization as a preferred mode of treatment for many types of hazardous waste. It is concluded that a program for adaptation of HLW vitrification technology to other wastes is clearly needed, and would have a high confidence of making major beneficial impact on the safe and efficient disposal of mixed and transuranic wastes. 20 refs., 2 tabs.

12551 (WSRC-TR--90-391) **A suite of RS/1 procedures for chemical laboratory statistical quality control and Shewhart control charting.** Shanahan, K.L. Westinghouse Savannah River Co., Aiken, SC (USA). Sep 1990. 75p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. Order Number DE91009297. Source: OSTI; NTIS; GPO Dep.

A suite of RS/1 procedures for Shewhart control charting in chemical laboratories is described. The suite uses the RS series product QCA (Quality Control Analysis) for chart construction and analysis. The suite prompts users for data in a user friendly fashion and adds the data to or creates the control charts. All activities are time stamped. Facilities for generating monthly or contiguous time segment summary charts are included. The suite is currently in use at Westinghouse Savannah River Company.

12552 (WSRC-TR--90-526-Rev.1) **Evaluation of experimental factors that influence the application and discrimination capability of the Product Consistency Test: Revision 1.** Jantzen, C.M. Westinghouse Savannah River Co., Aiken, SC (USA). Oct 1990. 52p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91009291. Source: OSTI; NTIS; GPO Dep.

Liquid high-level nuclear waste will be immobilized at the Savannah River Site (SRS) by vitrification in borosilicate glass. The glass will be fabricated in the Defense Waste Processing Facility (DWPF) where the glass will be poured into stainless steel canisters for eventual disposal in a geologic repository. In order to comply with the Waste Acceptance Preliminary Specifications (WAPS) the durability of the glass needs to be measured during production in order to demonstrate its long term stability and radionuclide release properties. A durability test, designated the Product Consistency Test (PCT), was developed for DWPF glass in order to meet the WAPS requirements. The response of the PCT procedure was based on extensive testing with glasses of widely differing compositions. The PCT was determined to be very reproducible, yield reliable results rapidly, and be easily performed in shielded cell facilities with radioactive samples. In the study attached, Battelle Pacific Northwest Laboratory independently verified the optimum PCT test parameters for glasses of very similar composition. During this study the following four parameters were investigated: the test duration, necessity for leachate filtration, necessity for sample washing, and the optimum ratio of the sample surface area to leachant volume. 6 refs., 17 tabs.

12553 (WSRC-TR--90-527-Rev.1) **Use of DWPF redox measurement technique on glasses from West Valley Nuclear Fuel Services Demonstration Project: Revision 1.** Jantzen, C.M. Westinghouse Savannah River Co., Aiken, SC (USA). Oct 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91009295. Source: OSTI; NTIS; GPO Dep.

Liquid high-level nuclear waste will be immobilized at the Savannah River Site (SRS) by vitrification in borosilicate glass in the Defense Waste Processing Facility (DWPF). A similar vitrification facility exists at the West Valley Nuclear Fuel Services. In both of these facilities, control of the oxidation/reduction (redox) equilibrium in the glass melter is critical for processing of the nuclear waste. Redox can be determined by measuring the ratio of ferrous to ferric ions in the glass melt. A colorimetric procedure has been developed for the DWPF which has been shown to give rapid and reliable analytical results. This colorimetric technique has been shown to measure the Fe^{2+} component of glasses more accurately than other existing redox measurement methods. The DWPF redox technique was applied to a series of six glasses taken from the West Valley melter during a transient melter excursion. This excursion caused the glasses to become progressively more reducing with time. Application of the DWPF redox technique to these glasses correctly indicated the redox trends with a higher precision and with more accuracy than the West Valley wet chemical method and/or Alfred University's Mossbauer method. 1 fig., 18 refs.

12554 (WSRC-TR--90-528-Rev.1) **The determination of the Fe^{2+}/Fe^{3+} ratio in simulated nuclear waste glass by ion chromatography: Revision 1.** Jantzen, C.M. Westinghouse Savannah River Co., Aiken, SC (USA). Oct 1990. 77p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. Order Number DE91009296. Source: OSTI; NTIS; GPO Dep.

Liquid high-level nuclear waste will be immobilized at the Savannah River Site (SRS) by vitrification in borosilicate glass in the Defense Waste Processing Facility (DWPF). In this facility, control of the oxidation/reduction (redox) equilibrium in the glass melter is critical for processing of the nuclear waste. Therefore, the development of a rapid and reliable analytical method for the determination of the redox equilibrium is of considerable interest. Redox has been determined by measuring the ratio of ferrous to ferric ions in the glass melt. Two analytical techniques for glass redox measurement have been investigated for the DWPF: Mossbauer Spectroscopy which may be subject to interferences from the radiation in actual waste, and a rapid and simple chemical dissolution/spectrophotometric technique. Comparisons of these techniques have been made at several laboratories including Clemson University. In the study attached, the determination of the redox ratio by Ion Chromatography (IC) was investigated as a potential new technology. Clemson University performed IC analyses on the same glasses as previously examined by wet chemical and Mossbauer techniques. Results from all three techniques were highly correlated and IC was reported to be a promising new technology for redox measurement. 19 refs., 19 figs., 5 tabs.

12555 (WSRC-TR--90-539-Rev.1) **Nuclear waste glass Product Consistency Test (PCT), Version 3.0: Revision 1.** Jantzen, C.M.; Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (USA). Nov 1990. 30p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. Order Number DE91009294. Source: OSTI; NTIS; GPO Dep.

Liquid high-level nuclear waste will be immobilized at the Savannah River Site (SRS) by vitrification in borosilicate glass. The glass will be produced in the Defense Waste Processing Facility (DWPF), poured into stainless steel canisters, and eventually disposed of in a geologic repository. In order to comply with the Waste Acceptance Preliminary Specifications (WAPS), the durability of the glass needs to be measured during production to assure its long term stability and radionuclide release properties. A durability test, designated the Product Consistency Test (PCT), was developed for DWPF glass in order to meet the WAPS requirements. The response of the PCT procedure was based on extensive testing with glasses of widely different compositions. The PCT was determined to be very reproducible, to yield reliable results rapidly, and to be easily performed in shielded cell facilities with radioactive samples.

0530 Environmental Aspects

Refer also to citation(s) 12480, 13427, 13466, 13467, 13470, 13471

12556 (WHC-MR--0222) **Hanford Waste Vitrification Plant technical background document for best available radionuclide control technology demonstration: Final report.** Carpenter, A.B. (Ebasco Services, Inc., Bellevue, WA (USA)); Skone, S.S.; Rodenhizer, D.G.; Marusich, M.V. Westinghouse Hanford Co., Richland, WA (USA); Ebasco Services, Inc., Bellevue, WA (USA). Oct 1990. 135p. Sponsored by USDOE,. DOE Contract AC06-87RL10930. Order Number DE91007170. Source: OSTI; NTIS; INIS; GPO Dep.

This report provides the background documentation to support applications for approval to construct and operate new radionuclide emission sources at the Hanford Waste Vitrification Plant (HWVP) near Richland, Washington. The HWVP is required to obtain permits under federal and state statutes for atmospheric discharges of radionuclides. Since these permits must be issued prior to construction of the facility, draft permit applications are being prepared, as well as documentation to support these permits. This report addresses the applicable requirements and demonstrates that the preferred design meets energy, environmental, and economic criteria for Best Available Radionuclide Control Technology (BARCT) at HWVP. 22 refs., 11 figs., 25 tabs.

0540 Health and Safety

Refer also to citation(s) 12535, 12556, 12857, 12884, 12898, 13216, 13427

12557 (ANL/RP–72572) **Derivation of uranium residual radioactive material guidelines for the Elza Gate Site.** Cheng, J.J.; Yu, C.; Devgun, J.S. Argonne National Lab., IL (USA). Feb 1991. 26p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. Order Number DE91008962. Source: OSTI; NTIS; INIS; GPO Dep.

Residual radioactive material guidelines for uranium were derived for a large, homogeneously contaminated area at the Elza Gate Site in Oak Ridge, Tennessee. The derivation of the single-nuclide and total uranium guidelines was based on the requirement that the 50-year committed effective dose equivalent to hypothetical individual who lives or works in the immediate vicinity of the Elza Gate Site should not exceed a dose of 100 mrem/yr following decontamination. The DOE residual radioactive guideline computer code RESRAD was used in this evaluation. Four potential scenarios were considered for the site: the scenarios vary with regard to time spent at the site, sources of water used, and sources of food consumed. The results of the evaluation indicate that the basic dose limit of 100 mrem/yr will not be exceeded for uranium within 1000 years, provided that the soil concentration of uranium at the Elza Gate Site does not exceed the following levels: 1800 pCi/g for Scenario A (industrial worker: the expected scenario); 4000 pCi/g for Scenario B (recreationist: a plausible scenario); 470 pCi/g for Scenario C (resident farmer using pond water as the only water source: a possible but unlikely scenario); and 120 pCi/g for Scenario D (resident farmer using well water as the only water source: a possible but unlikely scenario). The uranium guideline applies to the total activity concentration of uranium isotopes in their natural activity concentration ratio of 1:1: 0.046. These guidelines are calculated on the basis of a dose of 100 mrem/yr. In setting the actual uranium guideline for the Elza Gate Site, the DOE will apply the as low as reasonably achievable (ALARA) policy to the decision-making process, along with other factors, such as determining whether a particular scenario is reasonable and appropriate. 10 refs., 3 figs., 7 tabs.

12558 (DOE/ORO–914) **Interim report of the DOE [Department of Energy] Type B Investigation Group: Cesium-137, a systems evaluation, encapsulation to release at Radiation Sterilizers, Inc., Decatur, Georgia.** Hultgren, R.O. Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. Jul 1990. 183p. Sponsored by USDOE,. Order Number DE91008210. Source: OSTI; NTIS; INIS; GPO Dep.

Sometime between April 28, 1988, and June 5, 1988, a 22-inch long by 2.625-inch diameter doubly encapsulated cesium-137 irradiation source began leaking in the RSI-Decatur, Georgia, irradiation facility. By November 1988 when the source was isolated, between 7 and 8 curies (0.4 grams) leaked. This source was one of 1576 produced at Hanford to isolate the highly radioactive elements of wastes stored in single-walled tanks there. The capsule was designed for long term storage in a benign controlled pool environment on the Hanford reservation. This investigation evaluates the cause of the incident, the management and administrative matters including leasing and licensing, the capable design and manufacture, and the capsule qualification process. As a result, only two post-incident activities are discussed in the report. The first is the administrative characteristics of the early incident response, and the second is the results of the evaluation to date of the failed and other capsules from the RSI facility. 11 figs., 10 tabs.

12559 (DOE/ORO–914-App.C) **Interim report of the DOE [Department of Energy] Type B Investigation Group: Appendix C, Oral statements about the RSI [Radiation Sterilizers, Inc.] incident.** Hultgren, R.O. Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. Jul 1990. 325p. Sponsored by USDOE,. Order Number DE91008211. Source: OSTI; NTIS; INIS; GPO Dep.

Sometime between April 28, 1988, and June 5, 1988, a 22-inch long by 2.625-inch diameter doubly encapsulated cesium-137 irradiation source began leaking in the RSI-Decatur, Georgia, irradiation facility. By November 1988 when the source was isolated, between 7 and 8 curies (0.4 grams) leaked. This source was one of 1576 produced at Hanford to isolate the highly radioactive elements of wastes stored in single-walled tanks there. The capsule was designed for long term storage in a benign controlled pool environment on the Hanford reservation. An investigation was conducted to evaluate the cause of the incident, the management and administrative matters including leasing and licensing, the capsule design and manufacture, and the capsule qualification process. This Appendix presents transcripts of oral testimony taken during this investigation and is include as an integral part of the factual data upon which the Findings of this report are based. The transcriptions in every case were made available to the individuals involved for correction of factual misstatements and to be cleaned of verbal idiosyncrasies that detract from the meaning of the text.

12560 (DOE/ORO–914-App.D) **Interim report of the DOE [Department of Energy] Type B Investigation Group: Appendix D, Licensing correspondence.** Hultgren, R.O. Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office. Jul 1990. 414p. Sponsored by USDOE,. Order Number DE91008212. Source: OSTI; NTIS; INIS; GPO Dep.

Sometime between April 28, 1988 and June 5, 1988, a 22-inch long by 2.625-in. diameter doubly encapsulated cesium-137 irradiation source began leaking in the RSI-Decatur, Georgia, irradiation facility. By November 1988 when the source was isolated, between 7 and 8 curies (0.4 grams) leaked. This source was one of 1576 produced at Hanford to isolate the highly radioactive elements of wastes stored in single-walled tanks there. The capsule was designed for long term storage in a benign controlled pool environment on the Hanford reservation. An investigation was conducted to evaluate the cause of the incident, the management and administrative matters including leasing and licensing, the capsule design and manufacture, and the capsule qualification process. This appendix presents licensing correspondence.

12561 (DOE/RL–91-01) **Hanford Federal Facility Agreement and Consent Order quarterly progress report for the period ending December 31, 1990.** USDOE Richland Operations Office, WA (USA). Feb 1991. 85p. Sponsored by USDOE,. DOE Contract AC06-87RL10930. Order Number DE91009214. Source: OSTI; NTIS; GPO Dep.

This is the seventh quarterly report as required by the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1990), also known as the Tri-Party Agreement, established between the US Department of Energy, the US Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology). The Tri-Party Agreement sets the plan and schedule for achieving regulatory compliance and cleanup of waste sites at the Hanford Site. This report covers progress for the quarter that ended December 31, 1990. A total of 75 milestones have been completed to date. Twenty of the 23 milestones originally scheduled for completion during the quarter that ended December 31, 1990 were completed on or ahead of schedule. The three milestones not yet completed (M-10-04, M-24-00, and M-24-07) encountered technical difficulties. 29 refs., 1 fig.

12562 (PNL-SA–18882) **Remedial Action Assessment System (RAAS): A computer-based methodology for conducting feasibility studies.** Buelt, J.L.; Stottlemyre, J.A.; White, M.K. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 17p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910287–4: National research and development conference on the

control of hazardous materials, Anaheim, CA (USA), 20-22 Feb 1991). Order Number DE91008207. Source: OSTI; NTIS; INIS; GPO Dep.

Because of the great complexity and number of potential waste sites facing the US Department of Energy (DOE) for potential cleanup, the DOE is supporting the development of a computer-based methodology to streamline the remedial investigation/feasibility study process required for DOE operable units. DOE operable units are generally more complex in nature because of the existence of multiple waste sites within many of the operable units and the presence of mixed radioactive and hazardous chemical wastes. Consequently, Pacific Northwest Laboratory (PNL) is developing the Remedial Action Assessment System (RAAS), which is aimed at screening, linking, and evaluating established technology process options in support of conducting feasibility studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). It is also intended to do the same in support of corrective measures studies required by the Resource Conservation and Recovery Act (RCRA). This paper presents the characteristics of two RAAS prototypes currently being developed. These include the RAAS Technology Information System, which accesses information on technologies in a graphical and tabular manner, and the main RAAS methodology, which screens, links, and evaluates remedial technologies. 4 refs., 3 figs., 1 tab.

12563 (PNL-SA–18998) **Underground tank remediation by use of in situ vitrification.** Thompson, L.E. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-910270–24: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008748. Source: OSTI; NTIS; INIS; GPO Dep.

Pacific Northwest Laboratory (PNL) is developing a remedial action technology for underground storage tanks through the adaptation of the in situ vitrification (ISV) process. The ISV process is a thermal treatment processes that was originally developed for the stabilization of contaminated soil contaminated with transuranic waste at the Hanford Site in southeastern Washington for the Department of Energy (DOE). The application of ISV to underground storage tanks represents an entirely new application of the ISV technology and is being performed in support of the DOE primarily for the Hanford site and the Oak Ridge National Laboratory (ORNL). A field scale test was conducted in September 1990 at Hanford on a small cement and stainless steel tank (1-m dia.) that contained a simulated refractory sludge representing a worst-case sludge composition. The tank design and sludge composition was based on conditions present at the ORNL. The sludge contained high concentrations of heavy metals including lead, mercury, and cadmium, and also contained high levels of stable cesium and strontium to represent the predominant radionuclide species present in the tank wastes. The test was highly successful in that the entire tank and surrounding soil was transformed into a highly leach resistant glass and crystalline block with a mass of approximately 30 tons. During the process, the metal shell of the tank forms a metal pool at the base of the molten soil. Upon cooling, the glass and metal phases were subjected to TCLP (toxic characteristic leach procedure) testing and passed the TCLP criteria. Additional sampling and analyses are ongoing to determine the bulk composition of the waste forms, the fraction of volatile or semi-volatile species released to the off-gas treatment system, and to determine whether any soil surrounding the monolith was contaminated as a result of the ISV process. 4 refs., 5 figs., 3 tabs.

12564 (PNL-SA–19002) **Remedial Action Assessment System: A computer-based methodology for conducting feasibility studies.** White, M.K.; Buelt, J.L.; Stottlemyre, J.A. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 16p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910270–20: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008745. Source: OSTI; NTIS; INIS; GPO Dep.

Because of the complexity and number of potential waste sites facing the US Department of Energy (DOE) for potential cleanup, DOE is supporting the development of a computer-based methodology to streamline the remedial investigation/feasibility study process. The Remedial Action Assessment System (RAAS), can be used for screening, linking, and evaluating established technology processes in support of conducting feasibility studies. It is also intended to do the same in support of corrective measures studies. The user interface employs menus, windows, help features, and graphical information while RAAS is in operation. Object-oriented programming is used to link unit processes into sets of compatible processes that form appropriate remedial alternatives. Once the remedial alternatives are formed, the RAAS methodology can evaluate them in terms of effectiveness, implementability, and cost. RAAS will access a user-selected risk assessment code to determine the reduction of risk after remedial action by each recommended alternative. The methodology will also help determine the implementability of the remedial alternatives at a site and access cost estimating tools to provide estimates of capital, operating, and maintenance costs. This paper presents the characteristics of two RAAS prototypes currently being developed. These include the RAAS Technology Information System, which accesses graphical, tabular and textual information about technologies, and the main RAAS methodology, which screens, links, and evaluates remedial technologies. 4 refs., 3 figs., 1 tab.

12565 (UCRL-JC–105782) **Adaptation of the IBM ECR [electric cantilever robot] robot to plutonium processing applications.** Armantrout, G.A. (Lawrence Livermore National Lab., CA (USA)); Pedrotti, L.R.; Halter, E.A.; Crossfield, M. Lawrence Livermore National Lab., CA (USA). Dec 1990. 14p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910223–13: 4. topical meeting on robotics and remote systems, Albuquerque, NM (USA), 24-28 Feb 1991). Order Number DE91007614. Source: OSTI; NTIS; INIS; GPO Dep.

The changing regulatory climate in the US is adding increasing incentive to reduce operator dose and TRU waste for DOE plutonium processing operations. To help achieve that goal the authors have begun adapting a small commercial overhead gantry robot, the IBM electric cantilever robot (ECR), to plutonium processing applications. Steps are being taken to harden this robot to withstand the dry, often abrasive, environment within a plutonium glove box and to protect the electronic components against alpha radiation. A mock-up processing system for the reduction of the oxide to a metal was prepared and successfully demonstrated. Design of a working prototype is now underway using the results of this mock-up study. 7 figs., 4 tabs.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 13024

12566 (SAND–91-0190C) **PAMTRAK: A personnel and material tracking system.** Anspach, J. (EG and G, Inc., Albuquerque, NM (USA). Kirtland Operations); Wayne, P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9009345–1: American Nuclear Society (ANS) conference on facility operations: safeguards interface, Albuquerque, NM (USA), 29 Sep 1990). Order Number DE91008254. Source: OSTI; NTIS; GPO Dep.

The nuclear industry uses sensitive or classified parts and material that must be protected and accounted for. We believe there is a need for an automated system that can help protect and inventory these parts and material. In response to this need Sandia National Laboratories Division 5245 is developing a personnel and material tracking system named PAMTRAK to safeguard sensitive parts and material at selected Department of Energy facilities. This paper describes the project's background, design goals and features.

12567 (SAND–91-0325C) **Vulnerability analysis of manufacturing systems: A systematic method for protecting industrial production from disruption.** Kjeldgaard, E.A. (Sandia National Labs., Albuquerque, NM (USA)); Vannoni, M.G.; Varnado, G.B.; Hockert, J.W. Sandia National Labs., Albuquerque, NM (USA). [1991]. 7p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910279–10: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991; TTC–1061). Order Number DE91008576. Source: OSTI; NTIS; GPO Dep.

The USDOE initiated the Production Risk Evaluation Program (PREP) at Sandia National Laboratories (SNL) to asses quantitatively the potential for serious production disruption as the result of random failures, accidents, natural disasters, or sabotage at its facilities. SNL developed a procedure incorporating both network and fault tree models that identifies production vulnerabilities. For each production step, a steady-state flow model computers the "critical time," which is the maximum period a step can be shut down without preventing the system from achieving production goals. The critical time is then used in fault tree analysis to determine the failure modes that can stop the process for longer than this period. Modular logic modeling is used for constructing the fault trees. Equipment restorable within its critical time need not be considered critical even though it may perform significant work. This paper focuses on sabotage, but the methodology is applicable to analyzing the other production system vulnerabilities mentioned above. The PREP models can be used to identify those plant areas to which a saboteur would need to gain access. A security strategy using graded protection based on a PREP analysis potentially could reduce security costs. PREP methods also provide quantitative insights to develop protection measures that do not infringe upon the liberties of personnel or complicate work practices. 2 refs., 1 fig.

0560 Legislation and Regulations

Refer also to citation(s) 12477, 12480, 12525, 12538, 12792

12568 (INIS-XN–287) **Code of practice for the control and safe handling of radioactive sources used for therapeutic purposes (1988).** 1988 11p. Order Number DE91621708. Source: OSTI; NTIS (US Sales Only); INIS.

This Code is intended as a guide to safe practices in the use of sealed and unsealed radioactive sources and in the management of patients being treated with them. It covers the procedures for the handling, preparation and use of radioactive sources, precautions to be taken for patients undergoing treatment, storage and transport of radioactive sources within a hospital or clinic, and routine testing of sealed sources.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

12569 (WSRC-RP–89-1315) **Flow in a metal hydride chromatographic column.** Nichols, G.S. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 8p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. (CONF-9009141–11: International symposium on metal-hydrogen systems, Banff (Canada), 2-7 Sep 1990). Order Number DE91007926. Source: OSTI; NTIS; GPO Dep.

The flow of hydrogen isotopes in a metal hydride chromatographic column is calculated by a one-dimensional finite difference method. The Ergun equation is used to define the gas flow; and equilibrium pressure isotherms are used to define the column holdup. Solid phase loadings are shown to move as a wave front on absorption, but remain more uniform on desorption. 3 refs., 4 figs.

0702 Radiation Sources

12570 (CEAC-R–3-90) **Dosimetry in air in the product 1 gamma irradiator.** Espinosa Echavarria, R. (Instituto de Investigaciones de la Industria Alimenticia, La Habana (Cuba)). Comision de Energia Atomica, La Habana (Cuba). 1990. 10p. (In Spanish). Order Number DE91623392. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper are presented the results of the dosimetry in air in the product-1 gamma irradiator of the Research Institute of the Food Industry. The dose was measured with the Fricke system. This dosemeter was used for the determination of the dose distribution in the irradiator container. It was obtained the minimum, maximum and overall average value of the dose. The calibration functions of the plant well time, evaluated using linear regression analysis, present very good adjustment for these parameters when it was chosen four different settings for the well time. The dose uniformity ratio is 1.3. 11 refs.

12571 (CONF-9010243–13) **Enriched vs non-enriched vs non-fissile targets for pulsed spallation neutron sources.** Carpenter, J.M. Argonne National Lab., IL (USA). [1990]. 15p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. From International collaboration on advanced neutron sources; Tsukuba (Japan); 21-26 Oct 1990. Order Number DE91007657. Source: OSTI; NTIS; INIS; GPO Dep.

Numerous options exist among alternatives for target material and design of the neutron producing target in pulsed spallation neutron sources. This report surveys the advantages, disadvantages and limitations of some of the alternatives, including discussions of neutron yields, delayed neutron backgrounds, source pulse widths, source-to-moderator coupling, materials performance, fabrication problems, safeguards and security and hazards questions. 5 refs., 5 figs., 2 tabs.

12572 (DOE/ER/40339–4) **[Fast neutron cross section measurements]: Progress report.** Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering. [1991]. 25p. Sponsored by USDOE,. DOE Contract FG02-87ER40339. Order Number DE91008508. Source: OSTI; NTIS; INIS; GPO Dep.

In the 14 MeV Neutron Laboratory, we have continued the development of a facility that is now the only one of its kind in operation in the United States. We have refined the klystron bunching system described in last year's report to the point that 1.2 nanosecond pulses have been directly measured. We have tested the pulse shape discrimination capability of our primary NE 213 neutron detector. We have converted the RF sweeper section of the beamline to a frequency of 1 MHz to replace the function of the high voltage pulser described in last year's report which proved to be difficult to maintain and unreliable in its operation. We have also overcome several other significant experimental difficulties, including a major problem with a vacuum leak in the main accelerator column. We have completed additional testing to prove the remainder of the generation and measurement systems, but overcoming some of these experimental difficulties has delayed the start of actual data taking. We are now in a position to begin our first series of ring geometry elastic scattering measurements, and these will be underway before the end of the current contract year. As part of our longer term planning, we are continuing the conceptual analysis of several schemes to improve the intensity of our current pulsed beam. These include the provision of a duoplasmatron ion source and/or the provision of preacceleration bunching. Additional details are given later in this report. A series of measurements were carried out at the Tandem Dynamatron Facility involving the irradiation of a series of yttrium foils and the determination of activation cross sections using absolute counting techniques. The experimental work has been completed, and final analysis of the cross section data will be completed within several months.

12573 (EUR–12727, pp. 65-85) **Neutron radiography in Europe for industry and research techniques, facilities and applications.** Markgraf, J.F.W. (Commission of the European Communities, Petten (NL). Joint Nuclear Research Center). Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

Neutron radiography is a non-destructive inspection and testing technique capable of producing images of components, assemblies and materials, on film or real time devices, using neutrons as the penetrating irradiation. In comparison to X- and gamma-rays, neutrons penetrate heavy metals like steel, lead and uranium much more easily, whilst at the same time having the unique capability to image light materials such as hydrogen-bearing materials. Neutron radiography services for nuclear and non-nuclear applications are being provided by several research institutes and organizations in the European Community. This contribution summarizes basic information on the principles of neutron radiography, a selection of

typical applications, an outlook into future prospects of the technique and a survey of the European neutron radiography facilities.

12574 (JAERI-M–90-194) **Proceedings of the workshops on the utilization of electron beams.** Machi, Sueo (ed.) (Japan Atomic Energy Research Inst., Takasaki, Gunma (Japan). Takasaki Radiation Chemistry Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 168p. (CONF-9007204–: Workshops on the utilization of electron beams; Workshops on the utilization of electron beams, Bangi (Malaysia); Jakarta (Indonesia), 17 Jul 1990; 20 jul 1990; CONF-9007205–). Order Number DE91755676. Source: OSTI; NTIS (US Sales Only); INIS.

Workshops organized by JAERI in cooperation with UTN, BATAN and JAIF on the utilization of electron beam (EB) were held in Malaysia and Indonesia on 17 and 20 July 1990, respectively. These proceedings compile 11 papers presented at the Workshops, which are indexed individually. Welcome remarks, opening address and closing remarks are also recorded. Trends in industrial application and recent advances in high EB machine in the world were presented as the first part of the Workshops. Potential application of EB machine in Malaysia and Indonesia were discussed. Details of the crosslinking of wire/cable and rubbers with EB were introduced as the practical applications of EB in Japan. BATAN presented the experiences on radiation curing with a low energy EB machine. Sterilization of medical products and food irradiation with EB were reported by JAERI and UTN. BATAN presented prospect of commercialization of food irradiation in Indonesia. Application of EB as well as γ-ray to agro-resources was also discussed with special interest in the production of animal feed. (J.P.N.).

08 HYDROGEN

0801 Production

12575 (ENET–8900052/1) **HYDROSOL: solar hydrogen production at the SMA site in Payerne: Conceptual study, pre-project, cost estimation.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). May 1990. 58p. (In German). Order Number DE91749215. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

This study examines the possibility of using photovoltaically powered electrolysis to produce all or part of the hydrogen needed at the Swiss Meteorological Centre in Payerne to fill meteorological balloons. Four concepts were investigated. The best proved to be the one in which the solar generator is coupled with the electrolyzer unit on the DC side and draws its momentary energy shortfall from the mains. It is recommended to follow up and implement this concept with a photovoltaic generator output of 15 kW. 16 figs., 7 tabs., 7 refs.

12576 (FRCEA-TH–322) **Preparation and optimization of membrane electrode assemblies. Application to water electrolysis.** Millet, P. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); Institut National Polytechnique, 38 - Grenoble (France). Sep 1989. 199p. (In French). Order Number DE91753120. Source: OSTI; NTIS (US Sales Only).

A new preparation process of membrane electrode assemblies is developed. A perfluorosulfonated membrane is exchanged with one or more noble metal salt (s) (Pt, Ir, Ru...), then treated by a reducing solution of sodium borohydride. Metal deposit is localized on the membrane surface by control of reduction parameters (internal deposit for catalysis and external for electrodes). Total voltage of the electrolytic cell is decomposed in different terms (anodic and cathodic overvoltage, ohmic drop) to study influence of catalyst and metal impurities on performance. Tests at various temperatures and current densities show that cells can operate for thousands of hours. A small pilot cell producing 1 cu. m/day of oxygen was realized.

09 BIOMASS FUELS

0907 Resources

Refer also to citation(s) 13455

0908 Production

Refer also to citation(s) 12580

12577 (ETDE-mf–1756254) **Integral utilization of rape as a fuel and automotive fuel substitute in farming. Final report.** Scharmer, K.; Golbs, G. Gesellschaft fuer Entwicklungstechnologie mbH, Aldenhoven (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Sep 1990 41p. (In German). Contract BMFT 0318889A. Order Number DE91756254. Source: OSTI; NTIS (US Sales Only).

In this project the technical feasibility of the total utilization of the overground parts of rape plants as an energy source and as animal feed in farms was demonstrated. From the experiments and measurements, statements were derived regarding economic efficiency and the strategy to be adopted for introducing the products in the market. The products made frome rape seed and rape straw with the aid of the technical systems described are either used in the farm or marketed in the region: - cold pressed rape oil as 1. fuel for a modified diesel tractor, 2. transesterification into rape methyl ester as a fuel for series-produced diesel engines; - pressing residue from the rape expeller as a protein-rich fodder concentrate for animals, - rape straw pellets as solid fuel for furnaces. The demonstration was carried out on a farm at Ebelsbach/Franken with 40 hectares of rape crops and an average seed yield of 3 tonnes per hectare. Using an optimized harvesting technique it was possible to harvest 2.9-3 tonnes of rape straw per hectare. Economically efficient transfer to market with much larger processing capacities than in this project will have the following positive effects: - decrease of surpluses of farm products, - protection and creation of farm jobs, - cutting down of farming subsidies, - reduced environmental pollution load from fossil automotive fuels and fossil fuels. (orig.).

12578 (EUR–12718) **Optimization of biomass production in short-rotation Eucalyptus globulus plantations: Final report.** Pereira, H. (Instituto Superior de Agronomia, Lisbon (Portugal). Dept. de Engenharia Florestal); Pereira, J.S.; Madeira, M.; Almeida, H.; Chaves, M.; Fabiao, A.; Araujo, C.; Leal, L.C. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Instituto Superior de Agronomia, Lisbon (Portugal). Dept. de Engenharia Florestal; Celulose Beira Industrial, S.A., Figueira da Foz (Portugal). 1990. 39p. Sponsored by Com. Contract EN3B-0030-P. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The objectives of this project were the evaluation of the effects of soil nutritional and moisture conditions in the productivity of Eucalyptus globulus stands, and to study E. globulus genetic variability among populations of different provenances in terms of growth and cold tolerance. Optimized growth conditions were achieved by the weakly supply of a complete nutrient solution along with enough water to maintain soil water content above 80% of field capacity through daily irrigation during the growing season. The productivity in all treatments was linearly related with the leaf area index in each stand or the amount of radiation intercepted by the canopy. The proportion of stem in relation to total aboveground biomass was maximum in the irrigated-fertilized stands. To study the genetic variability among E. globulus populations we established in the spring time 1985 a set of provenance trials in 6 sites, covering situations from north to south and coastal to inland, in the area of this species in Portugal, to eliminate the environmental x genotype interaction. 33 refs., 9 figs., 13 tabs.

0909 Processing

Refer also to citation(s) 12587, 12959

12579 (ENET–8900650/1) **Wood gasification facilities in Europe in the 2 to 5 MWth range: Research project gasification of scrap wood, stage 1.** Nussbaumer, T.; Buehler, R.; Jenni, A. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Apr 1990. 74p. (In German). Order Number DE91749213. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The gasification of wood represents a meaningful alternative to combustion, because it enables a better level of fuel utilization and affords advantages when using scrap wood which contains heavy metals. Gasification in conjunction with a block-type thermal power station can be an economical proposition even today. A conclusive assessment is only possible, however, on the basis of experience gathered in the operation of pilot plants. Descriptions are given of plants in Switzerland and in other European countries. After drawing a comparison with conventional wood combustion, the study ends with a number of conclusions for the course of future actions. 12 figs., 2 tabs., 38 refs.

12580 (EUR–12736) **Commercial and marketing aspects of gasifiers.** Buekens, A.G.; Bridgwater, A.V.; Ferrero, G.L.; Maniatis, K. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. 250p. Sponsored by Com. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 20.

In both the industrial world and developing countries there is a steady and continuing interest in biomass gasification that has not yet been satisfied by the emergence of either a sufficiently reliable or a sufficiently cost effective technology. While there are still many operational gasifiers throughout the world and many studies have led to feasible gas producing processes, there are also too many failures to give gasification sufficient credence for it to achieve commercial success and economic viability. The objectives of the project, therefore, are to examine the status of gasification technology, assess the extent of commercial implementation, and evaluate the reasons for lack of commercial success to date. A historical survey of gasification is given in the annex to Chapter 1, Chapter 2 compares biomass fuels to the family of traditional fuels such as coal and oil. This is followed in Chapter 3 by the types of biomass, arisings and pretreatment requirements of raw biomass in order to produce a biomass "fuel" which can readily be used as a feedstock for the thermochemical conversion processes described in Chapter 4. This chapter reviews gasification technologies, and the following chapter reviews the ancillary operations necessary to produce a clean fuel gas. The various ways to utilize the clean fuel gas are considered in Chapter 6, while environmental considerations are addressed in Chapter 7. Chapter 8 continues the environment theme by considering health and safety aspects. Economic and market analyses are considered in Chapters 9, 10 and 11, and Chapter 12 summarizes key points and provides some conclusions. Further details of major aspects are elaborated in the Appendices which also include several case studies, relevant papers on the situation in several parts of the world, and results of a survey of biomass gasification activities. 96 refs., 53 figs., 89 tabs.

12581 (GB–295) **The use of landfill gas as a replacement fuel in a shell boiler: A demonstration at Premier Brands Ltd., Merseyside.** National Industrial Fuel Efficiency Services Ltd., Altrincham (UK); Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Feb 1988 35p. (ED–191/217). Order Number DE91750266. Source: OSTI; NTIS (US Sales Only).

The project, the first of its kind in the UK to extract methane from a mounded landfill site and fire the unrefined fuel in a Shell type steam boiler, has demonstrated that with a well-engineered installation the risk of interruption in the supply of landfill gas is small, and the gas can be successfully fired on conventional boilers without any major loss in efficiency. The overall thermal efficiency when operating on landfill gas was 77.1% (gross) compared with 78.4% (gross) on natural gas. A total of 1.048 million therms (110 594 GJ) was consumed during 1986 which represented 61.2% of the total fuel used by the boiler plant. The total energy savings amounted to 3952 tonnes of coal equivalent. The annual financial savings were directly related to the cost difference between landfill and natural gas. The capital cost of the project was pound140 743. The simple pay-back periods were from 6.6 years (at 20% discount) to 3.0 years (at 20% discount). (author).

0910 Properties and Composition

12582 (DOE/ER/13690–3) **[Characterization of lignin peroxidases from Phanerochaete]: Progress report.** Pennsylvania State Univ., University Park, PA (USA). 14 Nov 1990. 4p. Sponsored by USDOE,. DOE Contract FG02-87ER13690. Order Number DE91006730. Source: OSTI; NTIS; GPO Dep.

Work has continued on characterizing the kinetics of lignin peroxidases and has now expanded to include the chemistry of Mn peroxidases. Progress in these two area in addition to the authors work on the molecular biology of lignin biodegradation is briefly described below. Copies of two reprints and one preprint which have resulted from the work are attached.

0920 Combustion

Refer also to citation(s) 12580

12583 (GB–288) **The small scale use of poultry litter as a boiler fuel: A demonstration at A.J. Woodward and Sons [Tewkesbury].** Department of Energy, London (UK). Energy Efficiency Office; FEC Consultants Ltd., Oldham (UK). Mar 1990 21p. (EEO-NP–16). Order Number DE91756936. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

Annual savings of between Pound 62,200 and Pound 78,200 have been achieved by a broiler chicken production company to burn chicken litter as a fuel following the retrofitting of a semi-pyrolytic precombustor unit to an existing boiler. The capital cost of installing the combustion system and associated plant was Pound 76,500, giving a payback period of between 12 and 15 months on the initial investment. The heat produced is used to generate steam which is then used to heat seven broiler houses, each holding 30,000 birds, and half an acre of glasshouse for the year round growing of chrysanthemums. With the availability of cheap heat, it has been possible to increase ventilation rates while still maintaining the required temperature in the broiler houses. This has resulted in much drier bedding, greatly improved carcass grading and better control of the general health of the birds. The measured primary energy savings were 17,800 GJ/year (658 tonnes of coal equivalent). This takes into account the increased electricity consumption. The energy savings are worth approximately Pound 42,000/year. Investigations into the method of stockpiling and compositing of litter for re-use and/or burning were undertaken. These show that sufficient heat is being generated in the stacks to destroy any poultry pathogens likely to be present. Furthermore no trace of actinomycetes spores which are responsible for Farmers Lung was found. (author).

12584 (SVF–378) **Operating costs update, March 1990.** Stridsberg, S. (ISSAB Engineering, Genarp (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Aug 1990. 65p. (In Swedish). Order Number DE91753081. Source: OSTI; NTIS (US Sales Only).

Data from 41 swedish heating plants, using wood and peat fuels, on operating and maintenance costs, have been evaluated. The plants cover a power range of 1.5-84 MW. Concerning the fuels we have found that the plants are increasingly using mixed fuels, often wood and peat fuels. Almost half of the number use mixed fuels today and only 25% of them use pure fuel chips. The fuel quality has become better but we still have trouble with high water content, percentage of fines and foreign particles. The quality, specially water content, is balanced by mixing fuels. In fuel handling grabs have been introduced but still immersed reception bins with bar feeders are most frequent. Today we have very little trouble with all the different machine equipments. Even in burning equipment most of the former problems have been removed, troubles with ash sintering have been solved by flue gas recirculation and the combustion has been improved by better fuel and air distribution. We still find some

disturbances in the feding of fuel to the furnaces. Wear of the combustion equipment is not troublesome. Cleaning of the flue gases is now functioning well, some trouble with textile barrier filters remain. The handling of ashes and dust is improved to avoid dusting and wear. The accessibility of the plants has increased from 95 to 97% in the last three years. Mixed fuels tend to cause a little lower accessibility than the pure fuels, and fixed grates are burdened with stop time for slagging. Automatic grabs show a lower accessibility than other handling equipment but this might be understood as running-in problems in the newer plants. (author).

12585 (SVF–387) **Combustion related measures to reduce emissions from a woodfueled boiler with movable grate, moistening and recirculation of flue gas.** Schuster, R. (Energiteknisk Utveckling AB, Trosa (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Energiteknisk Utveckling AB, Trosa (Sweden). Dec 1990. 99p. (In Swedish). Project SVF-B7-938. (ETU–U-9018). Order Number DE91753064. Source: OSTI; NTIS (US Sales Only).

The object of the project was to evaluate the possibilities to reduce the NO_x-emissions for wood fired moving grate boilers by using different fuel qualities, by changing the operating settings, by moistening of the combustion air and by recirculation of flue gas. The NO_x-emissions varied between 60 and 200 mg/MJ. The analysis showed that the NO_x-formation increased at increased load. The emission decreased at decreased supply of secondary- and tertiary air. Secondary air supply gave lower emissions than tertiary air. Air leakage through the fuel bed and fuel supply increases the emission. Recirculation of flue gas decreases the NO_x-emission. Recirculation to the tertiary air supply was the most effective. Fuel nitrogen content and fuel moisture content gave no significant contribution to the NO_x-formation. Inhomogeneous fuel which jams on the grate and thereby causes air leakage increases the NO_x-emission. The best indicator of formation of NO_x is the oxygen content in the flue gas. The boiler produced very small amount of CO and THC. The SO_2-measurements showed very low values due to the small amounts of sulphur in the fuel and the alkalic ash which binds it. The N_2O-emission was between 0 and 4 ppm, with 2 ppm as mean value.

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 12580

12586 (NEI-DK–490) **Optimization of straw fueled 1 MW district heating systems.** Landsbyerne i Aalborg Kommune (Denmark). Aug 1990 49p. (In Danish). Contract ENS-UVE-88.1161. Order Number DE91752951. Source: OSTI; NTIS (US Sales Only).

In the commune of Aalborg in Denmark the advantages and disadvantages of initiating straw-fuelled district heating systems in the surrounding villages has been discussed. In order to give an improved basis for discussion a project was carried out which concerned an analysis of cost benefit of fuelling with straw in smaller district heating plants located in the villages of Vaarst and Fjellerad. It was attempted to rationalize the operation of the plants, the results of this attempt are discussed. Various forms of organization are described and calculations are made in relation to one of the district heating plants in order to discover in which way costs could be reduced. It was concluded that the economy could be improved if cooperation could take place with industrial consumers and if fatty slam could be used to substitute some of the straw. It is thought that the establishment of a straw fired 1MW district heating plant could be economically acceptable. (AB).

0950 Environmental Aspects

Refer also to citation(s) 12580, 12585, 13442

12587 (ANL/CP–71780) **Anaerobic burial of refuse in landfills: Increased atmospheric methane and implications for increased carbon storage: Draft.** Bogner, J.E. Argonne National Lab., IL (USA). [1990]. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9002171–1-Draft: SCOPE/IGBP workshop on trace gas exchange in a global perspective, Sigtuna (Sweden), 19-23 Feb 1990). Order Number DE91008816. Source: OSTI; NTIS; GPO Dep.

Anaerobic decomposition of landfilled refuse produces biogenic methane, most of which is vented to the atmosphere. Estimates for landfill methane emissions, based on worldwide solid waste quantities, range from less than 10 to more than 50 Tg/yr. Major controls on landfill methne-generation rates include water content, nutrient availability, and the volume and properties of interbedded soils. The dynamic process of methane movement through soil materials from the site of gas generation to the atmosphere is controlled by soil gas concentration and pressure gradients, as well as by properties of the porous medium, particularly moisture content. Examining percentages of cellulose, hemicellulose, and lignin in refuse that are not decomposed under optimal laboratory conditions suggests that widespread anaerobic burial of refuse also results in a significant increase in the amount of organic carbon entering long-term sedimentary storage. 46 refs., 7 figs., 3 tabs.

12588 (SB-UB–90-38) **Forest fuel and forest ecology.** Lundborg, A. Statens Vattenfallsverk, Vaellingby (Sweden). 16 Oct 1990. 34p. (In Swedish). Order Number DE91753035. Source: OSTI; NTIS (US Sales Only).

The report discusses different areas within the subject of environment and ecology in connection with biofuels, mainly the use of forest fuel: Nitrogen turnover of forest soils; Carbon dioxide and carbon balances in the forest ecosystem; Biofuel and the litter and humus of forest soils; Soil chemistry and soil biology; Positive ecological effects of broad-leaf trees; and Nature conservation. Several questions and gaps in our knowledge are identified in these areas.

0960 Health and Safety

Refer also to citation(s) 12580

0980 Waste Management

12589 (GB–315) **Demonstration of Beverley Comtro starved air incinerators with heat recovery: Ford Motor Co Ltd, Dagenham.** Scott, P.J. Department of Energy, London (UK). Energy Efficiency Office; Warren Spring Lab., Stevenage (UK). Jun 1989 24p. (EEO-ED–188/82). Order Number DE91752799. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Energy and waste disposal cost savings worth Pound 460,000/year have been achieved at the Ford Motor Company plant at Dagenham, Essex through the installation of a starved-air incineration system costing Pound 1.78 million and burning combustible waste at the plant to generate steam. Natural gas and coal consumption was reduced as a result. While the demonstration showed that overall savings could be significant, problems with the system which resulted in excessive maintenance costs and poor reliability, reduced net annual savings to Pound 81,000. The incineration plant employed was a Comtro system comprising two furnaces capable of burning 1.35 tonnes of waste each and a single duplex-type shell-and-tube boiler rated to generate up to 13,920 kg/h of steam. The furnaces comprised two refractory lines horizontal cylindrical chambers, one on top of the other. The primary chamber was used to provide starved-air combustion conditions and any unburnt gases and volatile material were carried into the secondary chamber to complete the combustion process. The incineration system is now working well and reliability is improving. It is anticipated that maintenance and operating charges will be reduced in the future and that more waste will be processed. Both of these factors will improve the economies of the system. (author).

12590 (GB–321) **Waste-fired steam boiler and baling plant: Demonstration at Silentnight Holdings plc [Colne].** Department of Energy, London (UK). Energy Efficiency Office; NIFES Consulting Engineers, Altringham (UK). Jul 1986 27p. (EEO-ED–84/155). Order Number DE91752797. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

A saving of Pound 77,276/year has accrued to Silentnight Holdings plc as a result of the installation of a system enabling waste

material to be used as the principal source of fuel. Silentnight had realised that the potential for using waste as a fuel was not being properly exploited at their Moss Factory, Barnoldswick. As a byproduct of its furniture manufacturing activities, Silentnight produces about 940 tonnes of wood waste and 600 tonnes of general wastes each year. An old incineration plant, with limited heat output, was used to dispose of some wood waste, whilst the remaining wood and fibre wastes were sent to landfill. The factory was heated primarily by an oil-fired Cochran boiler, with about 17% of the total heat requirement being provided by burning waste wood in the old incinerator. (author).

12591 (SVF–370) **Stabilisation and deposition of residues from cleaning of flue gas from municipal waste combustion.** Kullberg, S. (Statens Geotekniska Inst., Linkoeping (Sweden)); Faelliman, A.M.; Hoejlund, A. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Apr 1989. 234p. (In Swedish). Order Number DE91753057. Source: OSTI; NTIS (US Sales Only).

With 7 p. English summary.

A number of techniques are currently available for advanced cleaning of flue gases from municipal waste (MSW) combustion plants. The flue gas cleaning processes which are described in more detail are as follows: * SD - Semi-dry flue gas cleaning, * SDC - Semi-dry flue gas cleaning with condensing, * FC - Fluidised lime bed, and * C - Wet condensing flue gas cleaning. In this study, residues from the four different flue gas cleaning processes have been investigated with regard to principal chemical constitutents and heavy metal content, leaching properties, compaction properties and permeability. For purposes of comparison, the properties of the slag have been described using data from the ENA study. (Numerous figures, diagrams and tables. 25 refs.).

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 12312, 12313, 12314

12592 (DOE/PC/89762–T3) **NQR-NMR studies of higher alcohol synthesis Cu-Co catalysts: Quarterly technical progress report, September 14–December 15, 1990.** Grambling State Univ., LA (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89762. Order Number DE91008954. Source: OSTI; NTIS; GPO Dep.

The primary intent of our study is to investigate the magnetic character of copper-cobalt catalysts and examine the relation between catalytic and magnetic properties of the catalyst. The results reported in the previous report on the zerofield NMR spectra of a series of Cu/Co catalysts have been a serious concern due to the number of high frequency lines observed which did not fit the expected pattern. To further investigate this discrepancy, we have prepared again several catalysts in our laboratory and scanned the NMR/NQR spectra and studied the magnetization characteristics at Howard University during the Summer 1990. Two undergraduate physics majors made the magnetization studies using the vibration sample magnetometer system. 13 refs., 2 figs., 3 tabs.

12593 (Juel-Spez–580) **Methanol synthesis with CO_2-containing synthetic gas from natural gas reformation with H_2O and CO_2.** Riensche, E.; Hoehlein, B.; Fedders, H. Forschungszentrum Juelich GmbH (KFA) (Germany, F.R.). Inst. fuer Energieverfahrenstechnik. Aug 1990. 39p. (In German). Order Number DE91754695. Source: OSTI; NTIS (US Sales Only).

This report discusses the results of experiments with the conversion of natural gas into methanol carried out in the pilot plants. Variation of the operational parameters during reformation of natural gas with H_2O and CO_2 produced synthetic gases with different CO_2-contents and allowed to study the influence on the methanol yield, which drops with rising CO_2 contents. This is due to a shift in the thermodynamic balance and a slow down of the reaction kinetics. This behaviour can also be simulated with a kinetic mathematical model. (orig.).

13 HYDRO ENERGY

Refer also to citation(s) 12907

1301 Resources and Availability

12594 (KTM/E-D–187) **Numerical model for river ice: The final report of the river ice project.** Reiter, P. (Insoeoeritoimisto Reiter Oy, Helsinki (Finland)); Huokuna, M. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1990. 52p. (In Finnish). Project KTM-280/881/84. Order Number DE91752999. Source: OSTI; NTIS (US Sales Only).

In Finland rivers are ice-covered for several months every year and problems resulting from frazil ice and ice jams occur annually. A four-year river ice research project was started in Finland in May 1985 by the Finnish Power Plant Association, some hydroelectric power companies and the National Board of Waters and the Environment. The project is sponsored by the Ministry of Trade and Industry. The main purpose of the River Ice Project was to develop a numerical one-dimensional river flow model for winter conditions to be used as an engineering tool. By adjusting the flow conditions, it is possible to minimize the frazil production and to accomplish a smooth ice cover. By the same means the ice jams in the spring can be minimized. The field observations needed for development and calibration of the model have been carried out in four river stretches with lengths of approximately 40-70 km. The model is basically a one-dimensional flow model amended with models of heat exchange, water temperature, frazil ice and ice cover formation, and thermal growth and decay of ice cover. The model has already been successfully used in some applications. The river ice model can be used e.g. in the planning of watercourse projects, in the estimation of the environmental effects of the projects, in the flood protection, as well as in the planning of hydro power production and in the operational use of regulation.

1303 Plant Design and Operation

12595 (EFI-TR–3677) **Stochastic operation planning.** Roeynstrand, J. Energiforsyningens Forskningsinstitutt A/S, Trondheim (Norway). Feb 1990. 30p. (In Norwegian). Order Number DE91753004. Source: OSTI; NTIS (US Sales Only).

The report gives an account of experiments made with stochastic optimization of the operation of hydroelelectric power systems. One model based on stochastic optimization and Benders' partition procedures, and one scenario model have been tested on a small hydroelectric power system with stochastic water inflow. The results show that Benders' algorithm gives a better utilization of the water resources than the scenario model. 8 refs., 3 figs., 4 tabs.

1306 Environmental Aspects

12596 (DOE/EA–0449) **East Fork Salmon River habitat enhancement project: Environmental assessment.** USDOE Bonneville Power Administration, Portland, OR (USA). Office of Power Sales. Feb 1991. 142p. Sponsored by USDOE, Washington, DC (USA). (DOE/BP–1513). Order Number DE91008895. Source: OSTI; NTIS; GPO Dep.

The Bonneville Power Administration (BPA) proposes to fund several measures designed to enhance spawning and rearing habitat for anadromous (migratory) fish in two tributaries of Idaho's East Fork Salmon River. The project also will provide offsite mitigation for anadromous fish losses resulting from Snake and Columbia River hydroelectric developments. The East Fork Salmon River project is part of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (1982). The primary reasons for the decline in fish populations in the East Fork Salmon River drainage are the downstream development of hydroelectric facilities, compounded with the loss of habitat within the East Fork drainage due to past and present agricultural/ranching and mining activities. Stream banks in the drainage show the effects of grazing, including erosion and damage to vegetation. An abandoned power dam and a debris jam prevent fish from reaching parts of the drainage. Unstable banks along a stream diversion (cutoff

channel) at an inactive mine add sediments to the stream, some with tailings materials from the mine. 61 refs., 8 figs., 1 tab.

14 SOLAR ENERGY

12597 (BFR-D–20-90) **Simulation and evaluation methods for solar energy systems.** Perers, B. (Studsvik Energy, Nykoeping (Sweden)); Karlsson, B.; Walletun, H. Swedish Council for Building Research, Stockholm (Sweden). 1990. 87p. Project BFR-871200-1. Order Number DE91753069. Source: OSTI; NTIS (US Sales Only).

Based on more than 10 years of experiences from measurement and evaluation of solar energy systems in Sweden, and from international cooperation within the IEA SH and C programme, we have put together some important results and methods. The simulation part of the project deals mainly with detailed simulations for different ideas for performance improvement at high latitudes. The energy output per m^2 of collector field can be increased by a factor of almost two compared to the standard high efficiency flat plate collector arrays used today. External reflectors, suntracking, medium concentration ratios and shadowing in a collector field have been investigated. The storage requirement in a seasonal storage system decreases slightly, at 75% solar fraction, for most of the new collector arrays investigated. The evaluation part of the project deals with effective dynamic models and methods for evaluation and simulation. The goal of the methods is to separate the effect of climate and operating conditions from component performance and to give effective models for 1 hour time step that can be used in detailed simulation programmes like MINSUN and TRNSYS. The methods are so accurate that in most cases outlayers or strange results have been found to be due to errors in measurement sensors or system operation. (authors).

1401 Resources and Availability

12598 (ENET–8900335/1) **Calculating the effect of the horizon on global radiation over randomly oriented areas: Evaluation of the method and recipe for METEONORM.** Kunz, St. (Meteotest, Bern (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Dec 1989. 34p. (In German). Order Number DE91749222. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

METEONORM gives the basic principles for calculating global radiation over randomly oriented areas at any location in Switzerland. However, there is no indication as to how the reduction in global radiation by the horizon should be taken into account. This report explains two methods of measuring the horizon: taking account of the horizon when calculating the direct radiation in the 3-component monthly mean model from METEONORM; taking account of the horizon when calculating diffuse radiation. The influence of the horizon is represented in the form of nomograms. With the help of a small number of case examples from the Alpine region it is possible to see what variations in global radiation can be expected as a result of the terrain of the Alpine valleys. Finally, a proposal is put forward as to how the extensions of the model can be incorporated into METEONORM. 11 figs., 2 tabs., 2 refs.

12599 (SLU-LBT–69) **Measuring light levels and light transmission in greenhouses.** Nilsson, Goeran. Swedish Univ. of Agricultural Sciences, Lund (Sweden). Dept. of Farm Buildings. Sep 1990. 42p. (In Swedish). Order Number DE91753026. Source: OSTI; NTIS (US Sales Only).

In some cases it is very interesting to study the light distribution on a large surface i.e. to define the light transmission through the greenhouse roof construction or to map the light distribution over a cropping plan. In this work, an equipment for light measuring on large surfaces, constructed at the department, was used (Bengtsson, 1989). The intention of the work was to show the possibility of measuring light on large surfaces and to defining the light distribution. Further more, to discuss the possibility if defining the light distribution over a surface by measuring at one point only i.e. outdoor. The study showed the importance of measuring the light distribution over a cropping plan i.e. to locate experimental plots correctly. Big differences can be found depending on the greenhouse construction, webs, lamps and so on. When using artificial light, during a long time, there can be big differences between light integrals for different plots. It was also shown that it is possible to measure the light in one point i.e. outdoor and then calculate the distribution on a large surface. In this case a uniformed light distribution for the surface was used. At cloudy conditions and artificial light there was a good conformity between calculated and measured light levels. Under clear conditions there was less conformity. But, using daily mean values at each point on the surface a better conformity between the calculated and measured values could be obtained. (author).

1403 Economic, Industrial, and Business Aspects

12600 (NEI-DK–491) **Solar energy drive 1990 in Storstroems administrative area.** Storstroems Amtskommune, Miljoekontoret, Nykoebing (Denmark). Oct 1990 75p. (In Danish). Contract ENS-UVE-90.0005. Order Number DE91752954. Source: OSTI; NTIS (US Sales Only).

In 1990, a regional campaign for information dissemination on solar heating plants for houses and public buildings was continued. The activities were a follow-up of a compaign which took place in 1989. It was directed towards plumbers and consumers. The result for the 1990 campaign was 142 new plants, compared to 176 i 1989 and 66 in 1988. (CLS).

1405 Solar Energy Conversion

Refer also to citation(s) 13182, 13527

12601 (ETDE-mf–1759408) **Photovoltaic indoor systems. Final report.** Amrhein, W.; Dietz, H.; Reymann, K. Bosch (R.) GmbH, Gerlingen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1990 127p. (In German). Contract BMFT 03E8619A2. Order Number DE91759408. Source: OSTI; NTIS (US Sales Only).

One of the objects of our research project was to clarify the influence of low charging currents on the charging behaviour of NiCd and primary cells, another one was to fit suitable battery-operated appliances with solar generators and to test them. NiCd cells with sintered electrodes showed charging efficiencies between 33% at 40deg C and 82% at 0deg C with charging currents of 0.1 I_{10}. With currents of 0.01 I_{10}, the efficiency was rated between 7,5% (40deg C) and 56% (0deg C). It is possible to charge primary cells (alkaline manganese) with low currents under defined conditions. When the charging currents were 0.01 I_{10} the quantity of energy drawn from the battery during the experiment could be increased by 3.5 times the primary available capacity. By means of performance characteristics, such as the relationship between the solar generator surface and the battery capacity and on the basis of the application profile as well as the expected solar energy, a number of appliances were selected, fitted with solar generators and tested. The results show, that by using photovoltaics the degree of equipment utilization increases and enables limited operations without a main charging device. It permits compensation of the self-discharge rate and saves primary batteries which are harmful to the environment. The use of photovoltaics is promising, especially in connection with units having low power requirements and in case of favourable solar energy supply. (orig.) With 18 refs., 9 tabs., 49 figs.

12602 (EUR–12359) **Photovoltaic power generation: European research and development: Participating contractors in the R and D programme of the Commission of the European Communities, Directorate-General XII, Science, Research and Development, 1989.** Caratti, G. (Commission of the European Communities, Brussels (Belgium)); Shock, R.A.W.; Reis, M. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Brussels (Belgium). 1990. 165p. Sponsored by Com. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg: Price: ECU 12.50.

This report contains brief summaries on research in the following areas: amorphous silicon solar cells: amorphous silicon and alternative materials: and photovoltaic pilot programme.

12603 (SERI/CP–213-4079) **Photovoltaic module reliability workshop.** Mrig, L. (ed.). Solar Energy Research Inst., Golden, CO (USA). [1990]. 300p. Sponsored by USDOE,. DOE Contract AC02-83CH10093. (CONF-9010316–: Photovoltaic module reliability workshop, Lakewood, CO (USA), 25-26 Oct 1990). Order Number DE91002120. Source: OSTI; NTIS; GPO Dep.

The paper and presentations compiled in this volume form the Proceedings of the fourth in a series of Workshops sponsored by Solar Energy Research Institute (SERI/DOE) under the general theme of photovoltaic module reliability during the period 1986–1990. The reliability Photo Voltaic (PV) modules/systems is exceedingly important along with the initial cost and efficiency of modules if the PV technology has to make a major impact in the power generation market, and for it to compete with the conventional electricity producing technologies. The reliability of photovoltaic modules has progressed significantly in the last few years as evidenced by warranties available on commercial modules of as long as 12 years. However, there is still need for substantial research and testing required to improve module field reliability to levels of 30 years or more. Several small groups of researchers are involved in this research, development, and monitoring activity around the world. In the US, PV manufacturers, DOE laboratories, electric utilities and others are engaged in the photovoltaic reliability research and testing. This group of researchers and others interested in this field were brought together under SERI/DOE sponsorship to exchange the technical knowledge and field experience as related to current information in this important field. The papers presented here reflect this effort.

1406 Photovoltaic Power Systems

Refer also to citation(s) 12602, 12603, 13020

12604 (ETDE/NL-mf–1747374) **The Terschelling solar and wind energy project.** Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Utrecht (Netherlands). Aug 1989 6p. (In Dutch, English). Order Number DE91747374. Source: OSTI; NTIS (US Sales Only).

The solar and wind energy project at the Hogere Zeevaartschool 'Willem Barentsz' on West-Terschelling was started within the framework of the second European demonstration programme for the development of new energy sources (1979-1983). The solar generator, peak power 50 kWp, and the wind turbine supply electricity to the nautical college. After its completion in 1983, the system met with several problems. Both the solar cell industry and the wind turbine industry were still in their infancy, but many lessons have been learned since. A number of adjustments have been made, both in the system components and in the system control. In May 1989 a new wind turbine, 75 kW, was installed. At present (August 1989), the system is fully operational. 1 fig., 6 ills.

12605 (EUR–12699) **Monitoring results 1986–1988 from the Huvudsta PV installation.** Andersson, M. (Swedish Inst. of Microelectronics, Kista (Sweden)); Blaesser, G.; Tournier, A. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Swedish Inst. of Microelectronics, Kista (Sweden); European Solar Test Installation, Ispra (Italy). 1990. 15p. Sponsored by Com. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

We present here some of the operational data obtained from the photovoltaic installation at Huvudsta near Stockholm during a two-year monitoring period. The plant was operated and the data were collected by IM (the Swedish Institute of Microelectronics) and sent to ESTI (European Solar Test Installation) which is part of the Joint Research Center (JRC) of the European Communities. This collaboration is very important in order to extend the collection of monitoring data from EC sponsored pilot and demonstration plants to those operating under climatic conditions different from those in the Mediterranean and central European countries.

1409 Solar Thermal Utilization

Refer also to citation(s) 12940

12606 (BFR-R–93-90) **Ingelstad solar district heating plant: Evaluation.** Dalenbaeck, J.O. (Chalmers Univ. of Tech., Goeteborg (SE). Building Service Engineering). Swedish Council for Building Research, Stockholm (Sweden). 1990. 44p. (In Swedish). Project BFR-880047-4;BFR-870995-1. Order Number DE91753076. Source: OSTI; NTIS (US Sales Only).

This experimental project have been subject to three evaluation project and two thorough rebuildings during the last 10 years. It has substantially contributed to increased knowledge, in Sweden and abroad, regarding building and operation of large solar district heating plants. Today the plant covers 65% of the space heating demand. At the start the corresponding figure was 15%. A marked increase in heat yield combined with reduced rebuilding cost means that the cost of heating today only is a fifth of the value valid at the start of the plant. (U.W.).

12607 (ENET–8900025-1) **Prediction of the usable heat produced by the solar installation in Huttwil (BE) by means of the code G^3: Project SOLARIN 2.** Lachal, B. (Centre universitaire d'etude des problemes de l'energie, Groupe de Physique Appliquee, Geneve (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jan 1989. 24p. (In French). Order Number DE91749219. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The SOLARIN 2 project has two goals: 1. Optimization - in close collaboration with the engineer responsible for construction - of an active solar system; 2. Using the G^3 program to forecast the system's output, measuring the output and improving the method of calculation. The study indicates that the solar system will supply around 1700 MJ/m^2 per annum, i.e. that it will save 20 tons of mineral oil a year. This very good yield is owed to the quality of the collectors and to the possibility of operating at low temperatures during the winter. Doubts concerning the G^3 results can be put down to a poor understanding of optical effects. 7 figs., 9 tabs., 6 refs.

12608 (NEI-DK–483) **Report with measurements from larger solar heating systems for domestic water heating: Brandholms Alle and Birkmosevej, Roedovre.** Mikkelsen, S.E. (COWIconsult (DK)); CLausen, I.-L. Dansk Teknologisk Inst., Taastrup (Denmark). Proevestationen for Solenergi. Feb 1990 57p. (In Danish). Order Number DE91752942. Source: OSTI; NTIS (US Sales Only).

The design and energy yield of five solar domestic water heating systems is described on the basis of measurements taken. All the systems were installed in 1988 in order to heat domestic water for five apartment blocks in Roedovre, Denmark. Three of them are 104, one is 136 and the other is 155 square meters in size. The construction of each solar heating system is illustrated by diagrams, descriptions of components and photographs. In addition to the measurements taken in order to illustrate the enery yields a short description of the economy and operation of the five systems is offered. (AB).

1410 Solar Collectors and Concentrators

12609 (ENET–8900025/2) **Recapitulation of the characteristics of CORNING/CORTEC solar concentrators 1978-1989: Project SOLARIN 2.** Lachal, B. (Universite de Geneve, GAP-Cuepe, Geneve (CH)); Budry, L.; Guisan, O. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Nov 1989. 21p. (In French). Order Number DE91749220. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The characteristics of the evacuated CORTEC solar collectors used in the SOLARIN 2 project are described. It is found that a highly reflective layer behind the collectors produces a considerable additional yield, even from collectors with a single selective layer. Collectors with a double selective layer are justifiable only if the 2nd layer has the same properties as the 1st. The production of double layers is full of risks and requires meticulous quality inspection. figs., tabs., 11 refs.

12610 (ETDE-mf–1754626) **Solar heating and cooling of buildings Colorado-Freiburg. Pt. A. Collector development.**

Final report. Philips GmbH Forschungslaboratorium, Aachen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 30 Jul 1980 38p. (In German). Contract BMFT ET 5041 Teil A. Order Number DE91754626. Source: OSTI; NTIS (US Sales Only).

Different types of evacuated tube collectors with selective absorber coats were studied under different climatic conditions in the USA (Colorado) and in the Federal Republik of Germany with the project focussing on solar hot-water preparation, heating and cooling systems in buildings. An introductory overview of this joint project is followed by a description of the structural features of one collector (Type IV): simple structure of the evacuated glass tubes, high transmission of the cover, sufficiently low front losses, reduction of thermal radiation losses by using selectively absorbing coats, excellent protection of these coats by inclusion in the vacuum. Data are given on the selective absorber coat of the collector tube, tube manufacturing, measurements (solar absorption, thermal emission), and on manufacturing control. The collector unit is discussed (detailed studies, test units, module versions for Colorado and Freiburg). Suggestions are made for the 'solarisation' of the glass cover (reduction of transmission coefficient of the glass cover panes as a result of a phototropic effect). (HWJ).

12611 (NEI-DK–488) **Measurements from Saltum heating plant.** Jensen, B. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Oct 1990 78p. (In Danish). Order Number DE91752949. Source: OSTI; NTIS (US Sales Only).

The report describes the measuring conditions and the results of a one-year measuring project on the 1012 m^2 large-scale solar heating plant in Saltum, North Jutland, Denmark. The solar plant consists of 80 solar collector modules connected to the district heating system of Saltum town, supplying approx. 267 consumers with heat. The total amount of solar energy produced in each month is given. In 1989 it reached a total of 437 MWh, which is somewhat more than 5.2% of the total heat delivered from the district heating system. The data obtained by automatic data logging of 28 parameters in 76% of the production hours of the system is used to describe the production and behavior of the plant during chosen days during summer and winter. On the sunniest summer days more than 37% of the 24 hour heat consumption was supplied by the solar plant. The logged data was reduced to a measured power curve for the solar plant. Also covered in the report is the performance of the simple control system of the plant and the balance of the 8 sub-systems of the solar collector field. (AB).

1420 Heat Storage

12612 (ENET–8900028/1) **Stone bed heat storage for high temperatures: Study performed by the SOTEL consortium for the Swiss Federal Office of Energy (BEW).** Fricker, H.W. (Sulzer Bros. Ltd., Winterthur (Switzerland)); Fueglister, A.; Notheisen, C. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. vp. (In DE,EN). Order Number DE91749214. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

This study set out to define a basic design for a storage unit and to determine such a storage unit's capacity, thermal properties, heat losses and costs. The type of basic design selected consists of rock-filled cylindrical containers measuring 2.3 m in diameter and 1.65 m in height, which are arranged side by side and on top of the other to form an hexagonal container 14 m in diameter and 25 m in height. With this design it was hoped to control the great differences between the thermal expansion of rock and steel. Thermal calculations were carried out using a code from the Paul Scherrer Institute. They showed it to be possible to achieve the desired temperature stratification. Problems are caused by the storage unit's loss of pressure. A 440 MWh storage unit in the Valais Alps was estimated to cost SFr 11 million or SFr 25 per kWh. It would appear justifiable to carry out further studies into rock-fill storage. figs., tabs., 9 refs.

12613 (ENET–8900417/1) **Latent heat storage: state of the art.** Keller, L. (Bureau d'Etudes Keller-Burnier, Lavigny (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Dec 1989. vp. (In French). Order Number DE91749218. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Up until now studies have dealt mainly with the storage unit and failed to consider the system as a whole. The problem of the heat exchangers has not been solved - commercial systems are ill-equipped for the daily storage of solar energy. Delayed crystallization causes problems during daily storage. As regards costs, a latent thermal storage unit can be competitive for passive solar energy systems and for small or medium-size seasonal storage units, but not at today's energy prices. The storage substances so far examined are not necessarily the best. Further substances have to be examined for seasonal storage units. figs., tabs., refs.

15 GEOTHERMAL ENERGY

1505 Economic, Industrial, and Business Aspects

12614 (DOE/ID/12850–4) **Geothermal Education Office summary report: First year of operations, January 1, 1990–December 31, 1990.** EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-89ID12850. Order Number DE91008524. Source: OSTI; NTIS; GPO Dep.

Our mission for 1990 was "to increase students' awareness and appreciation of geothermal energy with respect to both direct use and electrical power production." Hard work has accomplished much: using both responsive and pro-active techniques, the Geothermal Education Office has had national impact on K-12 curriculum as well as on general public awareness of geothermal energy.

1510 Direct Energy Utilization

12615 (ENET–8900123) **Geothermal heating systems: Design and operation parameters determined by measurements and calculations.** Burkart, R. (Polydynamics Ltd., Zuerich (CH)); Hopkirk, R.J.; Eugster, W.J.; Rybach, L. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Sep 1989. 63p. (In German). Order Number DE91749221. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

In order to exploit geothermal energy from shallow depths of between several tens of meters and a few hundreds of meters, about 3'000 space heating systems have been constructed in Switzerland over the past ten years using ground-coupled heat pumps and vertical tube heat exchangers. The majority of these are for heating single family villas, although some larger housing developments and municipal buildings with heating demands up to several hundred kilowatts are included in the total. The design and methods of construction have evolved on a largely empirical basis. However, since 1983 several experimental and theoretical studies have been set in motion to establish a technical and scientific basis and to examine the energy economics of such systems. The present report describes the coupling between the three fluid circuits: the heat transfer fluid in the ground source circuit (the VHE); the working fluid circuit in the heat pump; and the space heating system circuit. The critical design parameters are defined and in particular the temperatures in the VHE are discussed. These are seen to be dependent upon the VHE geometry, the fluid flow rate and the quality of the heat exchange between VHE and ground. The effects of the design features on the efficiency of the plant have been surveyed with the help of numerical computer modelling. The influences of length and diameter of heat exchange tubes and of the thermal conductivity of the ground are discussed. No essential difference between typical U-tube and coaxial tube VHE's is apparent. Seasonal coefficients of 3.0 and more are easily achieved from well-designed systems. Extended operation of VHE's has also been simulated following validation of the computer model against field measurements over several years. A small, permanent cooling of the surrounding ground is only measurable in the first meter around a VHE. (Abstract Truncated)

17 WIND ENERGY

1701 Resources and Availability (Climatology)

12616 (CONF-9009334–Summ., pp. 1, Paper 1) **Prospects for wind energy development in participating countries: Cape Verde.** Fonseca, J.P.B.D. American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Cape Verde, a small island nation off the coast of West Africa, has strategic significance for shipping and air travel between Africa and other continents. Cape Verde just signed an agreement with U.S. Agency for International Development to act as an intermediate stop between U.S. and Africa. Cape Verde also receives donor aid from many other countries. DANIDA, the Danish aid agency, has provided financing for wind development in coordination with RISO, the national wind energy laboratory of Denmark. Currently they have one Bonus wind turbine in a wind/diesel application and four Vestas 55 kW machines in addition to a 10 kW Aeroman. DANIDA plans to invest in 30 units in 1991. Wind resource data is available and appears to be very good. Currently 2% of the nation's 9 MW capacity is generated by wind. Solar represents 0.5% and the remaining comes from conventional sources. Only 80% of the population is grid-connected. Water-pumping and desalinization plants are high priority applications for wind technology. Cape Verde is environmentally conscious and aims to meet as much of its demand as possible from renewable energy sources. In addition, its close ties to West Africa make it a good stepping stone to the huge African market.

12617 (CONF-9009334–Summ., pp. 10, Paper 2) **Prospects for wind energy development in participating countries: Chile.** Tironi, E. (Corporacion de Fomento de la Produccion (CORFO), Santiago (Chile)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

A comprehensive wind measurement program is needed but some initial data has been collected and evaluated by various Chilean universities. The findings have led to the selection of several areas and applications for wind energy development. The highest potential for large wind system development is found in the northern region near Chuquicamata. This high plateau is the site of an energy-intensive copper mining operation. The mining companies located at the end of the grid are high energy consumers with the money and infrastructure to support a wind project. The University of Chile has measured annual wind averages of 8.5 m/s for 10 hrs/day in this region. Current generation by coal, heavy oil and diesel costs approximately 5.9 cents/kWh. The nearby city of Arica (7.5 cents/kWh) could utilize wind-generated electricity. A second potential location is Easter Island which lies quite a distance from the mainland of Chile. It has a small population but the high cost of diesel-generated electricity (10 cents/kWh) and the winds averaging 6 m/s for 6 hrs/day make it a good location for wind integrated in a diesel mini-grid as a fuel saver. Small scale wind systems have potential to electrify the over 200,000 rural villages that are not connected to the grid. The wind resource has not been widely studied and therefore specific sites are not identified. In many of these villages, water-pumping for irrigation would benefit their expanding fruit exports. Along the 3,000 mile coast of Chile there are numerous fisheries that require power for refrigeration. The southern region around Punta Arenas appears to have good wind to meet this need. Important in establishing the political will for the use of wind energy in Chile will be a wind measurement program. Seed money from the U.S. to support such an assessment program is needed.

12618 (CONF-9009334–Summ., pp. 8, Paper 3) **Study of wind potential in Costa Rica.** Valverde, J. (Instituto Costarricense De Electricidad, San Jose (Costa Rica)); Morales, E. American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Costa Rica has an installed capacity of 866 MW. Eighty-four percent is generated from hydropower at the cost of 5 cents/kWh and 16% from thermoelectric plants. Historically, demand has increased by 7% per year. In May 1989, the Costa Rican government issued an Executive Decree allowing private power generation. A law to legalize private power production was further enacted by the legislature in 1990 and the power purchase agreement is now being negotiated. Currently, ICE has an agreement with the California Energy Commission to provide assistance on a wind resource monitoring program for the purpose of large-scale wind development. The CEC selected Tejona as the best site of several potential sites. U.S. Windpower Company is the meteorological contractor for collection and analysis of the data. The measurement began January 1990 and is ongoing. The potential for a large-scale windfarm project as an outcome of this program is strong. A rural electrification plan exists but does not appear to hold a high priority within the government. Nevertheless, some potential exists for small dispersed power systems in the rural areas since only 60% of the population has electricity but funding for them is a potential barrier.

12619 (CONF-9009334–Summ., pp. 1, Paper 4) **Prospects for wind energy development in participating countries: India.** Patel, N.M. (Gujarat Electricity Board, Baroda (India)); Singh, N.K.; Thakur, S.S. American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Since 1960, the electricity demand in India has been out placing the increase in capacity, creating a shortfall in meeting the 50,000 MW demand currently. The government of India's response has been to establish a goal of 2,000 MW of wind energy by the year 2000. An extensive wind mapping program by the Dept. of New Energy Sources (DNES) identified the most prospective areas as Gujarat in the West, Tamil Nadu in the Southeast and Himachal Pradesh in the North. With several years of Danish grants from DANIDA, India now has 37 MW of wind energy installed; 16 MW are in Gujarat. Consisting of 55 kW to 100 kW, these machines have been partially manufactured in India through licensing agreements. The first prototypes were installed in May 1988. Now the program is moving toward larger systems. Both 150 and 200 kW prototype machines are expected to be ready by March 1991. A recently enacted government policy for purchase of private power gives some incentive to private power producers through a complex system of banking energy credits. Nevertheless, the major point of control of wind development remains with DNES and to a lesser degree with the regional energy boards.

12620 (CONF-9009334–Summ., pp. 2, Paper 5) **Prospects for wind energy development in participating countries: Indonesia.** Panggabean, L.M. (UPT-LSDE/BPP Teknologi, Jakarta (Indonesia)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Perusahaan Umum Listik Negara (PLN), the state-owned utility, with a generating capacity of 8,000 MW, provides electricity to only

30% of the population. Another 8,000 MW generated by captive power is encouraged by PLN. To meet demand growing at 16% annually, Indonesia will need to add 2,000 MW annually by the end of the decade. To make things worse, PLN's tariffs do not cover its costs. The only current activity with wind is the testing of a 20 kW Aeroman turbine funded by Germany. Performance results are said to look good. The need to electrify many remote islands particularly in the eastern regions is part of the government development initiatives. The government has concluded that small scale PV would be cost-effective for household electricity needs. The lack of existing wind speed data is a limitation to promoting wind as another solution to this need. The southern side of the islands are likely to have sufficient wind resources. In a cooperative program with Japan from 1979 to 1987, 16 locations without access to the grid were monitored for wind speed. The data, however, was collected at a 10 meter height. The first step to promoting wind energy development in Indonesia must include support for a wind measurement program to assess probably sites. Information on the cost of a measurement program and assistance with the proper collection and analysis of data would strengthen ties and help push Minister Habibi toward a favorable opinion of the use of wind energy. In addition, studies showing the most cost-effective applications for the technology and the potential for developing Indonesian manufacturing capability are another way to promote U.S. interests.

12621 (CONF-9009334–Summ., pp. 1, Paper 6) **Prospects for wind energy development in participating countries: Mali.** Hessou, V. (Centre Regional d'Energie Solaire (CRES), Bamako (Mali)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

The Centre Regional d'Energie Solaire (CRES) coordinates the public and private sector renewable energy activities for 11 West African nations. Seventy-five percent of the population areas they represent are rural with basic needs for water-pumping for human and animal drinking water and irrigation. Traditionally, hand pumps have been used. The ease of maintenance make hand pumps a first choice in many locations. Other applications for wind energy could be for grinding grain and for refrigeration of vaccines, meats and fish. Wind speeds appear best along coastal regions (5 m/s), making Senegal, Mauritania and Cape Verde the countries for which wind is being given consideration. Two of the barriers to the use of wind are (1) the fact that no good resource data exists to pinpoint potential sites (last measurements were done in 1951-55) and (2) past failures of wind systems due to poor maintenance support which have discouraged further consideration of the technology. Studies have been done with multi-bladed mechanical windmills from CWD in Holland. Savonius-type vertical axis systems have also been investigated.

12622 (CONF-9009334–Summ., pp. 1, Paper 7) **Prospects for wind energy development in participating countries: Mexico.** Whaley, A. (Centro de Investigacion en Energeticos y Desarrollo, Col. del Valle (Mexico)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Mexico is a top prospective market for U.S. wind industry exports. Obviously, the coming negotiations toward a free-trade agreement and Mexico's location as our close neighbor encourage a paralleling of interests. In addition, the central government has launched a significant rural electrification program that has already affected the U.S. wind industry sales and holds even more project potential. At the conference, an order for $60,000 worth of wind equipment was placed. Mexican government funding has been provided to private consultants in various regions to set up small dispersed systems for rural electrification. Recent correspondence with Mexican contacts indicates that windfarms may also be considered. The use of renewable energy sources has been given priority by the government even though Mexico is an important oil producing nation. Most of the oil produced goes to meet their high foreign debt obligations. In the near future, Mexico is expected to be a key market for U.S. equipment and services and increased attention to building business relationships should pay good dividends to the industry.

12623 (CONF-9009334–Summ., pp. 2, Paper 8) **Prospects for wind energy development in participating countries: Pakistan.** Ajmal, M. (Water and Power Development Authority (WAPDA), Lahore (Pakistan)); Shah, M.A.; Rizvi, S.A. American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

The country of Pakistan has been experiencing an increasing power demand and consequent shortfall to meet that demand. To keep pace with demand it will be necessary to add 1,000 MW each year. A previous investigation into the potential for use of wind energy in Pakistan was done in 1975 by an Australian consulting firm. That study determined that the windspeed was not sufficient for wind development in Pakistan. Until recently, most key decision-makers in WPDA and the government had used that study to disregard the need to investigate wind energy potential any further. During an AWEA-led technical mission to Pakistan in May 1990, new information was provided about technology advances and the government's interest in wind has been rekindled. U.S. industry can be instrumental in shaping the WAPDA wind measurement program. A feasibility study managed by a U.S. wind professional would help guide the program in the best methods for collection and analysis of the data. The potential for grid-connected wind energy development depends largely on that program. In respect to small wind systems, there is a great need to provide water and electricity for the 70% of the population that live in very small villages in vast remote areas of the country. One company in Karachi, Marin Limited, has manufactured over 40 multi-bladed mechanical windmills which have been installed in the desert areas but developing technical skills for maintenance of equipment in rural areas has been a problem. The area of greatest rural need is also the area of greatest wind potential; the Baluchistan coast which lies West of Karachi. Vast regions have no power and the very low water table makes hand pumps unusable. A few small cities are served by expensive diesel mini-grids. Fuel transportation costs over poor roads make wind/diesel hybrid systems a potential cost-saving alternative.

12624 (CONF-9009334–Summ., pp. 1, Paper 9) **Prospects for wind energy development in participating countries: Philippines.** Roncesvalles, J.R.C. (Local Water Utilities Administration (LWUA), Quezon City (Philippines)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Like other Pacific Rim countries the growth of electricity demand has severely taxed the government's ability to build new generating capacity. Power outages are a frequent nuisance in the Manila area and many corporations are setting up captive generating capacity to meet their needs. The government utility bureaucracy does not appear interested in exploring wind for bulk power. The lack of wind data and the inaccuracy of that which is available have led to a generalized belief that the windspeed is not sufficient for this application. With Japanese assistance money, a small windfarm (approximately a dozen 15 kW Yamaha turbines) has been installed on the north side of Luzon. No further information is available. The only other known wind equipment in the Philippines

is a U.S. manufactured Enertech system that was never properly installed, is not working, and may be the reason that there is no serious interest in wind energy. The Local Water Utilities Administration, however, has been charged with providing potable water to the population on several remote Philippine islands. Through a German government funding, they are proceeding on a $1 million program to use photovoltaics-powered water pumping at 15 sites. This will benefit 15-20 villages and a total of 100-200 households. Wind-powered water pumping could clearly offer a least-cost option in locations where the wind resource are determined sufficient. Mr. Roncesvalles seemed interested in wind-powered water pumping applications but voiced the necessity of convincing the government to investigate the technology. Assistance in preparing feasibility studies for 5-10 kW wind water-pumping systems and demonstrations of the technology as an alternative to diesel-powered systems is important for convincing policy-makers of wind's usefulness. Funding will need to come from US/AID or other sources for this.

12625 (CONF-9009334–Summ., pp. 1, Paper 10) **Prospects for wind energy development in participating countries: Somalia.** Jama, A.M. (National Agency for Electricity and Energy, Mogadishu (Somalia)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

Somalia is reported to have the highest windspeeds in Africa. Located at the tip of the horn of Africa between Ethiopia and Kenya, the prevailing northeast winds are nearly permanent. The only exception is when the winds switch direction to the southwest during the monsoon season. In 1985 under a UNDP program, RISO in Denmark began a pilot project. Since 1987, four 55 kW Bonus turbines have been installed in a diesel grid near Mogadishu, the capital. Initial problems with corrosion in the hot, humid environment were eventually corrected with acid resistant stainless steel bolts and epoxy coatings. There has been a continuous mechanical and electrical training program and the results have shown wind energy to be competitive, especially since Somalia has to import its oil. Mr. Jama is the principal person in charge of the wind program at the national utility. Plans for 1992-97 include a 5 MW of additional wind energy generation and extension of the grid. Funding has not been secured for this expansion. He is looking for support for further wind measurement equipment and funding for this 5 MW expansion. US/AID maintain a very small office with minimal funding support. A World Bank study is currently being done by Kennedy & Donkin of U.K. This is expected to show wind as economically attractive but it is not a full feasibility study.

12626 (CONF-9009334–Summ., pp. 1, Paper 11) **Prospects for wind energy development in participating countries: Turkey.** Temiz, A. (General Directorate of Electric Power Resources Survey and Development Administration, Ankara (Turkey)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

The General Directorate of Electric Power Resources (EIE) has been actively investigating the use of wind energy since 1983. National wind data has been collected at 114 stations by the state meteorological organization and with the help of the Turkish Scientific and Technical Research Institute (TUBITAK) a wind map of Turkey has been prepared. Several demonstration programs have been underway: (1) using 1.1 kW three-bladed Darrieus type wind turbine with battery storage for rural electrification; (2) using a 20 kW HAWT system for farm lighting and water-pumping; and (3) using a 6-bladed mechanical windmill to investigate pumping capacity and operational problems. Another organization in Turkey studying the use of wind energy is Istanbul Technical University. In the private sector, a 55 kW Vestas turbine from Denmark was installed in 1984 to supply power directly into industrial facilities at Altinyunus. Although all of the systems mentioned are foreign-manufactured, several local manufacturers in western Turkey make crude mechanical windmills. It appears that a genuine interest in wind energy exists in Turkey. The potential for U.S. involvement in Turkey's development will require developing a closer flow of communication with Mr. Temiz and other interested decision-makers.

12627 (CONF-9009334–Summ., pp. 18, Paper 12) **Creation of wind energy development organization: A step towards economical solution to our energy problems [Pakistan].** Ajmal, M. (Water and Power Development Authority (WAPDA), Lahore (Pakistan)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

This paper discusses the following: (1) justification of wind energy development; (2) factors which obstructed the development of wind potential in the past; (3) international assessment of wind potential in Pakistan and the importance of its development; (4) available wind potential in Pakistan; (5) capital cost comparison; (6) relevance of Indian wind energy project and preparation of feasibility report; (7) set up of the organization; (8) socio political impact; and (9) financing.

12628 (CONF-9009334–Summ., pp. 9, Paper 13) **Potential for wind mill application in Pakistan.** Shah, M.A. (Pakistan Council for Appropriate Technology (PCAT), Karachi (Pakistan)); Rizvi, S.A. American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

The electricity generation in Pakistan is based on hydroelectric generation & thermal plants. These stations are located in the southern and in the northern part of the country. These are interconnected. In the province of Baluchistan there is only one thermal station which is in Quetta. This is also connected to the national grid. In the coastal area of Sind electricity is widespread while in Baluchistan this is limited to only towns. The main constraints for rural electrification is the high cost. The paper discusses the economics of power generation by small wind generators, wind patterns, wind mill history in Pakistan, and the wind energy industry.

12629 (CONF-9009334–Summ., pp. 5, Paper 14) **Wind energy activities in Turkey.** Temiz, A. (General Directorate of Electrical Power Resources Survey and Development Administration, Ankara (Turkey)). American Wind Energy Association, Arlington, VA (USA); American Solar Energy Society, Boulder, CO (USA). [1990]. (CONF-9009335–Summ.: Wind energy applications and training symposium; Wind energy applications and training symposium; Wind energy applications and training symposium, San Francisco, CA (USA); Amarillo, TX (USA); Washington, DC (USA), 19-28 Sep 1990; 19- In *Wind energy applications and training symposium. Final report.* 120p. Source: OSTI; NTIS.

The paper describes the activities of the Electrical Power Resources Survey and Development Administration (EIE), which was established in 1935 for the purpose of generating electricity form surface and subsurface resources of Turkey and its utilization throughout the country. Two main activities are described: wind energy potential and the wind turbine generator system. The paper then briefly summarized activities in wind energy by the Istanbul Technical University, the Turkish Scientific and Technical Research Institute, and the private sector.

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 12622

1706 Wind Energy Engineering

Refer also to citation(s) 12604, 12628, 12629

12630 (ECN-C–90-058) **Verification of the 'Handbook design wind data wind turbines, version 2' and the ECN-reference spectrum.** Rademakers, L.W.M.M.; Curvers, A.P.W.M. Netherlands Energy Research Foundation, Petten (Netherlands). Dec 1990. 144p. (In Dutch). Contract NOVEM 24.300/0143;Project ECN 4002-01. Order Number DE91747340. Source: OSTI; NTIS (US Sales Only).

The two deterministic methods mentioned in the title are meant to describe loads on wind turbines. Both methods are validated by comparing the calculated fatigue loads during normal operation with measured loads of three wind turbines: the 25 m horizontal axis turbine (HAT), the 25 m HAT with 20 WPX blades operated as a stall-regulated turbine, and the 1 MW NEWECS-45 turbine. The calculations of the hinge moments and the swing moments (the ranges) in the blade roots of the three wind turbines are executed by means of the time simulation program PHATAS-II. The comparison of measurements and calculations has been carried out on the basis of annual spectra of the hinge and swing moments, which are deducted from the measurements and calculations by means of the rain flow counting method. 18 figs., 17 refs., 4 tabs., 13 apps.

12631 (NEI-DK–485) **Wind turbine blades made of laminated wood.** Rasmussen, P. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Dec 1990 25p. (In Danish). Contract TR-86.546. Order Number DE91752946. Source: OSTI; NTIS (US Sales Only).

The aim of the project was the development of wind turbine blades constructed of massive laminated wood specified to a windmill with the number of rotations being 31 rpm and a power output of 150 kW. The aerodynamics involved, the windmill's operation and the construction of the wings are described and the measurement data presented. It is claimed that the technological niveau of wooden blades equals that of blades made of fiberglass. (AB).

12632 (NEI-DK–486) **Measurements from DANmark 25 150 kW: Low wind windmill with wood laminated blades.** Lakkenborg, J.; Jensen, B. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Nov 1990 31p. (In Danish). Contract TR-86.546. Order Number DE91752947. Source: OSTI; NTIS (US Sales Only).

Measurements taken from the Danish manufactured DANmark 25 wind turbine are presented. The windmill has 13m massive wooden blades, and the aim was to ascertain the technological and economical validity of producing windmills with blades of this type and with the recently developed fastening system which it also bears. The efficiency was measured during a 682 hour period. The windmill itself, the methods of measurement, results hereof and the meteorological conditions are described. (AB).

12633 (SAND–90-2260) **Programmer's guide for LIFE2's rainflow counting algorithm.** Schluter, L.L. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 27p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009182. Source: OSTI; NTIS; GPO Dep.

The LIFE2 computer code is a fatique/fracture analysis code that is specialized to the analysis of wind turbine components. The numerical formulation of the code uses a series of cycle count matrices to describe the cyclic stress states imposed upon the turbine. In this formulation, each stress cycle is counted or "binsed" according to the magnitude of its mean stress and alternating stress components and by the operating condition of the turbine. A set of numerical algorithms has been incorporated into the LIFE2 code. These algorithms determine the cycle count matrices for a turbine component using stress-time histories of the imposed stress states. This paper describes the design decisions that were made and explains the implementation of these algorithms using Fortran 77. 7 refs., 7 figs.

12634 (TUD-WBMT–191) **Wind turbine models from measurements via parameter estimation and digital control via optimal capacitance output feedback.** Van Engelen, T.G. (Stichting Energieonderzoek Centrum Nederland (ECN), Petten (Netherlands)); Lekkerkerk, F.; Baltus. C.W.A.; Dekker, J.W.M.; Kock, Z.D.Q.P.; Haafkens, F.; Bongers, P.M.M.; Dijkstra, S. Technische Hogeschool Delft (Netherlands). Faculty of Mechanical Engineering and Marine Technology; Netherlands Energy Research Foundation, Petten (Netherlands); Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). Mar 1990. 189p. (In Dutch). Contract ECN 0890;Contract NOVEM 41.33-002.10. Order Number DE91747329. Source: OSTI; NTIS (US Sales Only).

The purpose of the study on the title subject is to develop verified dynamic models of wind turbines and the component systems by means of measurements in order to improve design, operation and control of existing and future turbines. The verification methods for dynamic models and digital controllers are tested at the 25 m horizontal axis wind turbine (HAWT) of the Netherlands Energy Research Foundation (ECN) in Petten. Attention is paid to theoretical and experimental model design and the aims of the control system. Next the characteristics of the HAWT are discussed, as well as the multivariable control method. The results of the study are deducted models and experimental data from controller performance testing. 43 figs., 52 refs., 18 tabs., 8 apps.

20 FOSSIL-FUELED POWER PLANTS

2001 Power Plants and Power Generation

Refer also to citation(s) 12317, 12318, 12808, 12810, 12913, 12949, 13052, 13056, 13066, 13071, 13072, 13073, 13074

12635 (ETDE-IT–91-10) **Steam generator component welds subject to creep (non-destructive techniques).** Maciga, G.; Mantini, G. Ente Nazionale per l'Energia Elettrica, Milan (Italy). May 1988. 19p. (In Italian). Order Number DE91752912. Source: OSTI; NTIS (US Sales Only); INIS.

In this examination of the effects of high temperature creep on pressure tube welding in steam generators attention is given to nondestructive techniques to detect and evaluate cavitation damage in ferritic steels. It is shown how these techniques - ultrasonic methods, positron annihilation, Barkhausen effect based methods and thermal wave imaging, are used to observe and evaluate a metal's microstructure and then to assess its residual life.

12636 (ETDE-IT–91-11) **High temperature corrosion in energy sector: R&D status.** Regis, V. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1988. 16p. (In Italian). Order Number DE91752913. Source: OSTI; NTIS (US Sales Only); INIS.

A survey is made of new materials and treatments being developed to combat high temperature corrosion problems affecting steam generator heat exchangers, gas turbine blades and other types of power generation equipment components directly exposed to combustion gases or subject to operation in highly corrosive environments. The temperature range dealt with is 400 to 1000 degrees C. The performances of carbon steels, austenitic steel alloys and ceramics are examined in conditions favouring oxidation, reduction, sulfidation and salt attacks.

12637 (ETDE-mf–1756208) **Coal power plant concept for the future. State of the art, testing and planning of new coal power plant technologies. Full version.** Pruschek, R. (Essen Univ. (Gesamthochschule) (Germany, F.R.)); Weber, E.; Renz, U. Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.). Mar 1990 229p. (In German). Order Number DE91756208. Source: OSTI; NTIS (US Sales Only).

This study reviews the state of development and planning of new coal power plant technologies for a more efficient and less polluting way of electric power generation than hitherto, on the precondition that industrial-scale operation will still be possible in the Nineties if

necessary. The publication will show the extent to which environmental pollution can be reduced, the development steps and funds required, and the obstacles to fast implementation. Assuming optimum values which still require verification by test plant operation, the following estimates are obtained: combined-cycle coal power plants with integrated coal gasification and with a performance factor of 46% (gas turbine inlet temperature 1150deg C) would use 14% less coal and 50% less cooling water and emit 14% less CO_2 than a reference coal power plant. Combined-cycle brown coal power plants with integrated coal gasification and with a performance factor of 47% (gas turbine inlet temperature 1070deg C) would use 23% less brown coal and 55% less cooling water, and CO_2 emissions would be lower by 23% than in the reference brown coal power plant. With the projected measures on the gas purification and furnace side, the emissions of SO_2 and NO_x may be reduced by up to 85% and the dust emissions by more than 90%. The solid residues (elemental sulphur, slag) can be utilized for industrial purposes or as constructional materials. Combined cycle power plants also have higher power characteristics than conventional steam power plants when used as heating stations. This has a positive effect on the energy conservation data of combined heat and power generation. (orig./GL).

12638 (IKU-R–34.2847.00/03/90) **Offshore gas power plant without emission of greenhouse gases, combined with enhanced oil recovery: Ad advanced and updated preliminary study.** Bolland, O. (Termisk Energi, NTH, Trondheim (NO)); Holt, T.; Lindeberg, E.G.B. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Apr 1990. 53p. (In Norwegian). Order Number DE91753016. Source: OSTI; NTIS (US Sales Only).

A preliminary study has been carried on to examine the possibility to use an offshore gas power plant to utilize the substantial amounts of gas for electric power production, and at the same time to deliver CO_2 in quantities that may be of interest for gas injection to enhance the oil recovery. Two different methods to produce CO_2 by stoichiometric combustion have been compared. One of them is based on combustion of pure oxygen, and the other of air. The various combustion processes in the turbins have been closely investigated with respect to thermodynamic conditions and technical fitness. Both of the concepts are technically realizable. The investment costs of the two power plant types are $1dl3x10^9$ NOK (Norwegian Kroner) and $14.0x10^9$ NOK respectively, for 1000 MW electric power brought ashore. This implies a payback period of 7.5 years and 6.4 years, corresponding to an internal interest rate of 12.7% and 15.2% respectively. The profitability analysis does not include tax. 27 refs., 13 figs., 18 tabs.

12639 (SIEMENS-KWU-E–331/90/001) **Combined-cycle power plant with integrated coal-gasification. Development program for raw gas/clean gas heat exchanger. Final report.** Emsperger, W.; Ganzer, W.; Kellner, J. Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.). Bereich Energieerzeugung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1990. 211p. (In German). Contract BMFT 03E-6232-D. Order Number DE91754799. Source: OSTI; NTIS (US Sales Only).

Within the scope of a development program for components of a combined cycle power plant with integrated coal gasification the operational behaviour of a raw gas - clean gas heat exchanger (RRWT), mounted in the PRENFLO-testing plant, was subjected to thorough investigations. The task of the RRWT is to heat-up the clean gas, leaving the cleaning unit with ambient temperature, by hot raw gas coming out of the waste heat boiler. This regenerative heating-up of the clean gas shall raise the overall efficiency by 0,5-1,0%. During operation period (March 1988 - April 1989) problems were expected on the raw gas side, caused by fouling of heating surfaces, corrosion and desublimation. Within the approx. 3000 service hours it turned out that the RRWT could be operated without any problems. Since high dust contents in the raw gas cause a rapid and severe fouling process, an efficient heating surface cleaning system is absolutely necessary. The experiences gained, led to a higher design certainty for a RRWT of the planned 160 MW-demonstration plant. (orig.) With 93 figs., 9 refs., 51 photos.

12640 (SVF–366) **Survey of organic material in makeup water.** Falk, I. (Studsvik Nuclear, Nykoeping (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Nuclear, Nykoeping (Sweden). Jan 1990. 42p. (In Swedish). Project SVF-K7-807. (STUDSVIK-NS–89-74). Order Number DE91753054. Source: OSTI; NTIS (US Sales Only).

In demineralization plants used for producing deionised water in power plants and industry the dimensions of the filters and ion exchange resins are mainly based upon the concentration of organic ions in the raw water. In order to determine how the organic substances are reduced in the different filters, and which concentrations remain in the deionised product, a study has been carried out which is reported here. The survey has been performed in the form of analysis campaigns in which water samples have been taken throughout the entire filtration period during normal operation. Subsequently the water samples have been analysed for TOC. The study has been performed at industrial plants in Skoghall and Moensteraas, as well as the power plants in Ringhals, Vaertaverket and Fyriskraft. The results show that the humus filter, in combination with a weak anion exchange resin, reduce the organic material by 87 and 77% in Skoghall and Moensteraas respectively. With a single bed weak anion exchange resin in Ringhals the reduction was higher: about 90%. The reduction with a strong anion resin was 5.4 and 13% in Skoghall and Moensteraas respectively, but much lower at the other plants where it was less than 2%. The strong anion resin in a mixed bed gave low reduction in all cases, probably because a certain fraction of the humus cannot be filtered by ion exchangers. Summarial diagrams of the mean values from the study show that the TOC concentration is lowest in the deionised water from Fyriskraft, 37 ppb. In the other plants the TOC concentration varies between 115 and 244 ppb. In order to produce deionised water from surface water with TOC concentrations below 100 ppb another technique is needed, for example membrane techniqua, with which more effective separations of colloidal humus substances can be achieved.

12641 (SVF–367) **Two-media cycles for heat production.** Murray, J. (Royal Inst. of Tech., Stockholm (SE). Dept. of Heat Technology); Olsson, E.; Svedberg, G. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Jan 1990. 67p. (In Swedish). Project SVF-E7-808. Order Number DE91753044. Source: OSTI; NTIS (US Sales Only).

One way to increase efficiency in converting chemical energy to electricity and heat is to develop new thermodynamic working cycles. In the refrigeration technology and in the heat pump technology, mixtures of two or more components have been used as working media during decades. Processes with multi-component working media have become interesting also for power production. An introductory study of two-media processes for heat and power production has been performed. The study has included a literature survey and contacts with scientists and companies working in this field. This report covers the thermodynamic basis for two-media cycles. Proposed cycles and possible applications are discussed. Possible working media are commented upon, as also the work with development of new media to replace the CFC compounds. Two-media processes are appraised to be most interesting for heat sources below approximately 600 deg C. This includes heat from gas turbine and gas engine exhausts and also industrial waste heat. Internationally, a lot of research work is performed concerning the use of two-media mixtures for Rankine cycles. Among the applications, power production from geothermal resources is prominent. Today, the Kalina cycle is the most interesting cycle. A mixture of ammonia and water is used as working medium. This cycle is believed to give considerably higher thermal efficiencies than the Rankine cycle in a combined cycle application with a gas turbine in the topping cycle. Proving of the real advantages of the Kalina cycle requires practical demonstration of the technology and further theoretical studies. Further work is recommended concerning the Kalina cycle. One interesting application is cogeneration. Generally, there is a need for more knowledge on two-media processes, possible couplings in cycles, working media, component design, materials etc. (authors).

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Refer also to citation(s) 12325, 12327, 12328, 12329, 12330, 12331, 12332, 12333, 12335, 12339, 12340, 12341, 12342, 12343, 12344, 12345, 12348, 12349, 12352, 12353, 12356, 12357, 12411, 12902

12642 (CONF-900858–, pp. 375-382) **Development and application of the integrated environmental control model.** Rubin, E.S. (Carnegie Mellon Univ., Pittsburgh, PA (USA)); Salmento, J.S.; Frey, H.C. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Over the past two decades, environmental regulations have transformed the design of new coal-fired power plants. Requirements for the control of air pollutants, water pollutants and solid wastes have added considerably to plant complexity, while spurring the development of new, more innovative technology for the removal of pollutants before, during and after combustion. This paper describes an analytical model which quantifies the performance and cost of power plant designs that involve user-specified combination, of precombustion, combustion, and post-combustion methods of environmental control. A unique feature of the Integrated Environmental Control Model (IECM) is the ability to characterize uncertainty in probabilistic terms, in contrast to conventional deterministic analysis. This capability offers special advantages in comparing advanced technologies at an early stage of development with conventional systems where uncertainties are smaller. This paper reviews the current status of model development and presents an illustrative example of its use. Plans for further model development also are summarized.

12643 (CONF-900858–, pp. 526-529) **SO_2/NO_x control system for coal-fired boilers.** Nelson, B.W.; Nelson, S.G. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Sanitech engineers for the past five years have been working on a new class of dry SO_2/NO_x sorbents. The new sorbents are a composite material, consisting of a low-cost mineral oxide, either MgO or CaO, bonded to a low-cost expanded silicate carrier, either vermiculite or perlite. This project was directed toward developing and demonstrating the new flue-gas treatment technology for use with coal-fired boilers. It involved an investigation of the removal of SO_2, NOx and particulates from power plant flue gases utilizing the new process. These sorbents in the form of a panel bed were exposed to a 1500-ACFM side stream of flue gas at Ohio Edison's Gorge Power Plant in Akron, Ohio. Although a half dozen sorbent compositions were investigated in the project, emphasis was placed on a regenerable sorbent having the composition, 45 wt% MgO-55 wt% Vermiculite. This composition showed outstanding performance in the past. Project objectives and conclusions based on the results of Phase I experiments are described.

12644 (DOE/FE–0212P) **Integrated dry NO_x/SO_2 emission control system: A project proposed by Public Service Company of Colorado: Comprehensive report to Congress Clean Coal Technology Program.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Jan 1991. 37p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008624. Source: OSTI; NTIS; GPO Dep.

In September 1988, Congress provided $575 million to conduct cost-shared Clean Coal Technology (CCT) projects to demonstrate technologies that are capable of retrofitting or repowering existing facilities. One of the projects selected for funding is the Integrated Dry NO_x/SO_2 Emission Control System demonstration project proposed by Public Service Company of Colorado (PSCC). This project will demonstrate the combined removal of NO_x and SO_2 from a down-fired utility coal boiler retrofitted with the Integrated Dry NO_x/SO_2 Emission Control System. The Integrated Dry NO_x/SO_x Emission Control System is a combination of different processes intended to reduce acid rain precursor emissions in utility flue gases. These processes are: low-NO_x burners and urea injection for NO_x control, sodium- or calcium-based sorbent injection for SO_x control, and flue gas humidification to enhance the reactivity of the SO_2 compound. 6 figs., 1 tab.

12645 (DOE/PC/88945–T4) **(1) Microbial removal of SO_2 and NO_x from flue gas; (2) Microbial by-product recovery from regenerable processes for the simultaneous removal of SO_2 and NO_x from flue gas: Final report.** Sublette, K.L. (Tulsa Univ., OK (USA). Dept. of Chemical Engineering); Suciu, D. Tulsa Univ., OK (USA). Dept. of Chemical Engineering. 1 Feb 1990. 155p. Sponsored by USDOE,. DOE Contract FG22-88PC88945. Order Number DE91008248. Source: OSTI; NTIS; GPO Dep.

The objective of this project has been to investigate the reduction of SO_2 to H_2S by Desulfovibrio desulfuricans in coculture with mixed fermentative heterotrophs and the reduction of NO to elemental nitrogen by Thiobacillus denitrificans. The ultimate goal has been the development of a viable process concept whereby a microbial process could impact on the problem of flue gas desulfurization and NO_x removal. It was observed that molasses will support the reduction of SO_2 to H_2S by working cultures of D. desulfuricans. However, the sulfur contained in the molasses resulted in H_2S production in excess of that expected based on the SO_2 feed. We demonstrated the reduction of nitric oxide (NO) to elemental nitrogen (N_2) by Thiobacillus denitrificans. We also investigated the simultaneous removal of SO_2 and NO from a gas by contact of the gas with either D. desulfuricans and T. denitrificans reactors-in-series or in co-culture. An economic evaluation of the microbial reduction of SO_2 was performed comparing the microbial process to a conventional catalytic SO_2 hydrogenation (with H_2 generation from methane). Microbial SO_2 reduction and conventional SO_2 hydrogenation were estimated to have similar costs in terms of capital investment. However, annual operating costs for the microbial process were much higher than the conventional process, due primarily to the cost of raw materials. 52 refs., 38 figs., 20 tabs.

12646 (DOE/PC/90361–T1) **Catalytic fabric filtration for simultaneous NO_x and particulate control: Quarterly technical progress report, October 1–December 31, 1990.** Weber, G.F. North Dakota Univ., Grand Forks, ND (USA). Energy and Environmental Research Center. Jan 1991. 14p. Sponsored by USDOE,. DOE Contract AC22-90PC90361. Order Number DE91008448. Source: OSTI; NTIS; GPO Dep.

The University of North Dakota Energy and Environmental Research Center (EERC), Owens-Corning Fiberglas Inc. (OCF), and Stearns-Roger, a division of United Engineers & Constructors (UE&C), have initiated a research project aimed at the development of a catalytic fabric filter for simultaneous NO_x and particulate control. Recent advances at OCF have shown that a high-activity catalyst can be applied to a high-temperature glass cloth, resulting in a fabric filter material that can operate at temperatures higher than commercially available, coated glass fabric. In bench-scale experiments, over 90% of the NO_x is removed by catalytic reduction with ammonia to form nitrogen and water. The catalyst employed at this time is vanadium/titanium, but the exact catalyst composition and the unique method of applying the catalyst to high-temperature glass fabric are the property of OCF. Other catalyst options are being evaluated by OCF in order to improve catalyst performance and minimize catalyst cost. 5 refs., 1 tab.

12647 (ENEA-RT-AMB–90-13) **Polycyclic aromatic hydrocarbons in coal power plant fly ash.** Caricchia, A.M.; Delle Site, A.; Di Palo, C. ENEA, Casaccia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo. Oct 1990. 14p. (In Italian). (RT/AMB–90-13). Order Number DE91752934. Source: OSTI; NTIS (US Sales Only); INIS.

In the determination of polycyclic aromatic hydrocarbons (PAH) present in ash samples of the thermoelectric power plant of Vado Ligure, the samples were: bottom ash, fly ash collected from the electrostatic precipitators (EP), and fly ash collected isokinetically just before the stack. The analytical procedure consisted of a pretreatment of the samples, followed by an extraction with benzene of the organic fraction, a purification of the extract by thin layer

chromatograhy on silica gel plates, and a further extraction of the PAH fraction with tetrahydrofuran. The final solutions obtained from the treatment of the bottom ash and of the EP ash were analyzed by gas chromatography-mass spectrometry (GC-MS) , while that obtained from the treatment of stack ash was analyzed by high performance liquid chromatography (HPLC). The concentrations of the PAH in the bottom ash ranged between 20 and 300 ng/g, those in the EP ash between 0.1 and 5 ng/g and those in stack ash between 60 and 1500 ng/g. The emission factors of the PAHs associated with the stack fly ash were also evaluated.

12648 (ETDE-mf–1759415) **ECE NO_x task force 'Technologies for controlling NO_x emissions from stationary sources'.** Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Industriebetriebslehre und Industrielle Produktion. Jul 1986 302p. Order Number DE91759415. Source: OSTI; NTIS (US Sales Only).

The aim of the report is to compile available information on NO_x control technologies for stationary sources and thus to support the Executive Body as well as member countries in developing NO_x control strategies. For this a technical-economic description and assessment of the present status and the ongoing development of the NO_x reduction technologies has been carried out. This report is based on information available up to the end of 1985. Since in most of the states participating, NO_x emissions from stationary sources occur mainly during fuel combustion for generation of heat and electricity, the report's main emphasis lies in the description of NO_x reduction technologies in large-scale (more than 50 MW_{th}) firing plants. Besides the technical description and evaluation of NO_x reduction measures, investments and costs of each measure are presented, as far as data available permit. Moreover, the development stage of individual procedures in the various states has been examined and an attempt has also been made to indicate development tendencies. (orig./KW).

12649 (NEI-DK–494) **Survey report of the projects: Characterization and management of waste water from desulfurization of flue gas by the wet absorption process with following oxidation. Biological removal of nitrogen from waste water from desulfurization of flue gas by the gypsum producing wet absorption process.** Energiministeriets Energiforskningsprogram. Miljoe og restprodukter. Holm Kristensen, G. (Vandkvalitetsinstituttet (DK)); Jepsen, S.-E.; Mose Pedersen, B.; Sund, C. Vandkvalitetsinstituttet, Hoersholm (Denmark); Krueger (I.) A/S, Copenhagen (Denmark). Sep 1990 30p. (In Danish). Contract EM-1323/87-10;Contract EM-1323/88-9. Order Number DE91752957. Source: OSTI; NTIS (US Sales Only).

EFP-87; EFP-88.

Aspects of the treatment of waste water from the wet desulphurization process dealt with are: data evaluation of the waste water before and after treatment, estimation of possible effluent standards, the origin and fate of heavy metals in the desulphurization process, the description and evaluation of potential processes for reduction of heavy metals, laboratory experiments with the chemical precipitation of waste water from West German power plants, laboratory experiments with biological denitrification at high temperature and with high salt and nitrate concentration, the evaluation of the applicability of external carbon sources (methanol and acetate), and the technical/economical evaluation of process alternatives prepared in the light of the investigations mentioned above. It is claimed that sulphide precipitation is a highly effective method to remove heavy metals from waste water. It is recommended to add ferric chloride to remove possible excess of sulphide after the precipitation, thereby preventing formation of hydrogen sulphide. By hydroxide/sulphide precipitation a dissolved concentration of mercury on < 0.5 $\mu g/l$ and a concentration of cadmium on approximately 6 $\mu g/l$ was achieved. It was possible with acetate as carbon source to obtain biological denitrification even at a concentration of 30,000 mg chloride/l and a temperatue of 40 deg. C. At higher temperature the denitrification rate decreased and stopped at 50 deg. C. The cost of construction for a treatment plant for removal of hevy metals by chemical precipitation and biological removal of nitrate including a plant for production of gypsum is estimated to be in the order of 30 million D.kr. and with annually operating costs of approximately 3.5 million D.kr. (1989). (AB).

12650 (SVF–368) **NO_x evaluation of the Vaesthamnsverkets coal boiler at Helsingborg.** Nordenberg, L. (Goetaverken Energy AB, Goeteborg (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Feb 1990. 60p. (In Swedish). Order Number DE91753045. Source: OSTI; NTIS (US Sales Only).

These tests have been performed in order to form a know-how basis for rebuilding the boiler to fulfil the NO_x-emission limits given by the local authorities. The tests comprise three different coal qualities: Polish, Venezuelan, and Colombian. The objective has been to achieve as low NO_x formation as possible and maintaining a low unburnt content. From the measurements the following conclusions can be drawn: The NO_x level decreases and the unburnt level rises at decreasing load. Low stoichiometry in the primary burning zone lowers the NO_x level drastically, but it also increases the unburnt. It seems like a coal with a high volatile content requires a lower stoichiometry to keep the NO_x level down. The residence time in a reducing atmosphere influences the NO_x level. A clear difference in the amount of NO_x formed has been achieved, depending on the burner combination which is in operation - the two upper or the two lower. Also tilting of the burners up- or downwards has an influence. The choice of burner combination and tilt angle has of course also an impact on the volumetric heat release rate, which influences the NO_x-emission. Alternating rich and lean combustion zones lower the NO_x level. The results from the optimization test can, if they are recalculated to an 8 hours reduced load at night and full load the remaining 16 hours of the day, be summarized in the following annual mean values: For the most favourable coal and with best burner combination in operation the annual average would be 113 mg NO_2/MJ. For the worst coal and with all burner combinations in operation the annual average would be 139 mg NO_2/MJ. (author).

12651 (SVF–386) **Operating experiences from power plants equipped with units for selective catalytic reduction of nitrogen oxide.** Larsson, Erik (AaF-Energikonsult, Stockholm (SE)); Leven, P. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Dec 1990. 107p. (In Swedish). Order Number DE91753049. Source: OSTI; NTIS (US Sales Only).

This is a presentation of operating experiences from power plants with selective catalytic reduction equipment. The report is concentrating on problems regarding start-up and stop procedures. The work has been done through literature studies as well as on site studies and discussions with suppliers and power plant personnel. The purpose has been to study the work done on minimizing the start-up time i.e. minimizing the time for uncleaned flue gas to be emitted. So far the main interest concerning start-up has been focused on ammonia injection in order to avoid ammonium bisulphate deposition. Early ammonia injection also increases the NH_3-slip because of low catalytic activity at temperatures lower than 300 deg C. Our conclusions is that the methods to be used in order to shorten the start-up period are as follows: During overnight stop and stops over weekend, insulation of the reactor combined with shut off of the flue gas is sufficient. After longer stops heating equipment can be used in order to keep the catalyst dry. The 'tail end' concept is originally equipped with heating facilities, which is said to be the main disadvantage. If a quick start is necessary this method can be the solution. When the tail end concept is used it is of great importance to use a flue gas reheater with minimum leakage. A leakage can be as serious as a long start-up time on the total cleaning efficiency. Other means are more indirect. All the suppliers of SCR-units we have been in contact with recommend primary measures such as low-NOX burners in combination with the SCR. This decreases the impact from the uncleaned period. A few examples showing the impact of start-up sequence and stop on the required total NO_x reduction efficiency are given. (authors).

12652 (VTT-TIED–1190) **Recovery of carbon dioxide from the flue and product gases of energy production processes.** Hepola, J. (Valtion teknillinen tutkimuskeskus, Espoo (Finland). Polttoainetekniikan laboratorio); Solantausta, Y.; Johansson, A. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1990. 62p. (In Finnish). Order Number DE91752994. Source: OSTI; NTIS (US Sales Only).

Carbon dioxide can be recovered from the exhaust gases and utilized or stored. There are a number of technical alternatives for

the recovery, while the utilization alternatives are limited and storage problems have not yet been decisively solved. As an example, we discuss a system, where about 20% of the carbon dioxide released from fuels in Finland (13.5 million t/a) would be recovered and stored in ocean floor gas wells. Compared with the present costs of electricity production, the costs would increase to about twofold at the power stations equipped with carbon dioxide recovery. In the example, the carbon dioxide is recovered only at the largest coastside coal power stations. The study indicates that a coal-fired gasification combined-cycle power plant is clearly more profitable than a natural gas fired combined-cycle plant or a conventional coal-fired power plant, if the carbon dioxide is recovered. This is mainly due to the fact that in a gasification combined-cycle power plant the carbon dioxide can be fixed from a pressurized (20-40 bar) and concentrated (about 40%) gas flow at moderate costs. In the other alternatives, the carbon dioxide has to be removed under atmospheric pressure from a flue gas flow with a carbon dioxide content of only 10-15%. Of the power plant concepts under development, a fuel cell power plant and a power plant using pure oxygen are of particular interest with regard to the reduction of carbon dioxide emissions. The efficiency of the former system is higher than that of the conventional power plant and hence, the specific emissions lower. When using pureoxygen, the carbon dioxide is recovered from a concentrated gas flow.

2005 Environmental Aspects

Refer also to citation(s) 12913

12653 (CONF-9004281–2) **Fossil fuel usage and the environment.** Klass, D.L. Institute of Gas Technology, Chicago, IL (USA). [1990]. 29p. Sponsored by Ins. From Asian natural gas II - a brighter '90s; Singapore (Singapore); 9-11 Apr 1990. Source: OSTI; Inst. of Gas Technology, 3424 S. State St., Chicago, IL 60616.

The Greenhouse Effect and global warming, ozone formation in the troposphere, ozone destruction in the stratosphere, and acid rain are important environmental issues. The relationship of fossil fuel usage to some of these issues is discussed. Data on fossil fuel consumption and the sources and sinks of carbon dioxide, carbon monoxide, methane, nitrogen and sulfur oxides, and ozone indicate that natural gas provides lower emission of carbon dioxide, carbon monoxide and nitrogen and sulfur oxides than other fossil fuels. Global emissions of methane from the gas industry are significantly less than those from other anthropogenic activities and natural sources, and methane plays an important role along with carbon monoxide and nitric oxide in tropospheric ozone formation. Reductions in any or all of these air pollutants would reduce ozone in the lower atmosphere. Several remedial measures have been or are being implemented in certain countries to reduce fossil fuel emissions. These include removal of emissions from the atmosphere by new biomass growth, fuel substitution by use of cleaner burning fuels for stationary and mobile sources, and fossil fuel combustion at higher efficiencies. It is unlikely that concerned environmental action by all governments of the world will occur soon, but much progress has been made to achieve clean air. 35 refs., 3 figs., 12 tabs.

2006 Economic, Industrial, and Business Aspects

12654 (IVO-B–03/90) **An introduction to financial and economic analysis.** Norrbaeck, M. Imatran Voima Cy (IVO), Helsinki (Finland). 1990. 54p. Order Number DE91752995. Source: OSTI; NTIS (US Sales Only).

The study aims at giving a view of the different evaluation methods and improving their use when preparing project feasibility studies. The work is a study of the literature in the subject mainly provided by international financial institutions and development agencies. The conventional project evaluation methods, especially the internal rate of return and the net present value methods, are useful when preparing project feasibility studies. Sensitivity analysis is proved to be useful in evaluation of projects, where the basic information is uncertain. Risk analysis can be used in large projects involving many risks. The financial analysis has been the starting point for the economic appraisal, but factors that lead to distorted prices have been adjusted. Factors that cause problems for the evaluation are, for example, inflation, overvaluation of currency, wages and under-employment. The price distortion is adjusted by shadow pricing. The last section considers the central problem which arises when appraising the economic worth of new types of generating plant: namely, that the operating costs of each chosen plant, over its lifetime, both depend upon and help to determine the choice of new plant during that period. The paper considers the background to the problem and gives a graphical presentation of the method. The feasibility of energy projects is usually very sensitive to the price of electricity. The shadow price of electricity is the alternative cost for production or the long run marginal cost. The social impact (income distribution etc.) of the projects can be evaluated in theory, but in practice the statistics normally available are insufficient for rigorous analysis.

2007 Legislation and Regulations

Refer also to citation(s) 12826

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 12848, 13057

12655 (INIS-mf–12784) **Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.** Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Selected items have been processed separately for inclusion in the database. (DLC)

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 12822, 12858, 12859, 12861, 12862, 12864, 13048, 13231

12656 (IAEA-TECDOC–577, pp. 25-39) **The SVEA BWR fuel: Eight years of further development.** Nylund, O. (ABB Atom AB, Vaesteraas (Sweden)); Hjaerne, L. International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

The SVEA concept represented a significant advancement in BWR fuel technology since it was first published in 1981. The objective of the SVEA development endeavour was to achieve a number of significant performance improvements by a radical redesign effort. There are two basic SVEA 5 x 5 designs, SVEA-100 and SVEA-96. Successful operation of demonstration assemblies since 1986 and later partial reloads precedes the deliveries of the first SVEA-100 and SVEA-96 full reloads in 1990. (author). 5 refs, 7 figs.

12657 (IAEA-TECDOC–577, pp. 41-45) **Reactor strategy and advanced fuel technology in Japan: Current status and future plan.** Saito, N. (Science and Technology Agency, Tokyo (Japan). Atomic Energy Bureau). International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

The Japanese programme on Advanced Fuel Technology shortly is reviewed in the paper. The programmes for FBR development,

testing LWR Advanced Fuels and Plutonium Utilization in LWRs and the schedule of the HTTR programme are briefly presented in the paper. (author). 4 figs.

12658 (IAEA-TECDOC–577, pp. 105-111) **Status of advanced fuels development in Switzerland.** Stratton, R.W. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

Since the previous IAEA meeting on Advanced Fuels in Wuerenlingen in December 1984, the Paul Scherrer Institute (formerly the Swiss Federal Institute for Reactor Research (EIR)) has continued to work on the development of advanced nuclear fuels for Fast Breeder Reactors (FBRs) and Light Water reactors (LWRs). A paper on EIR's advanced Breeder fuel development was given at the IAEA meeting on Advanced Fuels for Fast Breeder Reactors in Vienna on 3-5 November 1987. A paper on advanced mixed oxide fuels was recently presented at the IAEA technical meeting in Cadarache in November 1989. All of PSI's work over more than twenty years has been made using gelation techniques. (author). 7 figs.

12659 (JAERI-M–90-193) **ETAP user's manual.** Watanabe, Norio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Higuchi, Suminori. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 61p. (In Japanese). Order Number DE91755640. Source: OSTI; NTIS (US Sales Only); INIS.

The event tree analysis technique has been used in Probabilistic Safety Assessment for LWRs to delineate various accident scenarios leading to core melt or containment failure and to evaluate their frequencies. This technique often requires manual preparation of event trees with iterative process and time-consuming work in data handling. For the purpose of reducing manual efforts in event tree analysis, we developed a new software package named ETAP (Event Tree Analysis Supporting Program) for event tree analysis. ETAP is an interactive PC-based program which has the ability to construct, update, document, and quantify event trees. Because of its fast running capability to quantify event trees, use of the EATP program can make it easy to perform the sensitivity studies on a variety of system/containment performance issues. This report provides a user's manual for ETAP, which describes the structure, installation, and use of EATP. This software runs on NEC/PC-9800 or compatible PCs that have a 640 KB memory and MS-DOS 2.11 or higher. (author).

12660 (K/ITP–362) **Safeguards issues in spent fuel consolidation facilities.** Belew, W.L.; Moran, B.W. Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div. Jan 1991. 35p. Sponsored by U.S. DOE Contract AC05-84OT21400. Order Number DE91007984. Source: OSTI; NTIS; GPO Dep.

In the nuclear power industry, the fuel assembly is the basic unit for nuclear material accountancy. The safeguards procedures for the spent fuel assemblies, therefore, are based on an item accountancy approach. When fuel consolidation occurs in "at-reactor" or "away-from-reactor" facilities, the fuel assemblies are disassembled and cease to be the basic unit containing nuclear material. Safeguards can no longer be based on item accountancy of fuel assemblies. The spent fuel pins containing plutonium are accessible, and the possibilities for diversion of spent fuel for clandestine reprocessing to recover the plutonium are increased. Thus, identifying the potential safeguards concerns created by operation of these facilities is necessary. Potential safeguards techniques to address these concerns also must be identified so facility designs may include the equipment and systems required to provide an acceptable level of assurance that the international safeguards objectives can be met when these facilities come on-line. The objectives of this report are (1) to identify the safeguards issues associated with operation of spent fuel consolidation facilities, (2) to provide a preliminary assessment of the assessment of the safeguards vulnerabilities introduced, and (3) to identify potential safeguards approaches that could meet international safeguards requirements. The safeguards aspects of spent fuel consolidation are addressed in several recent reports and papers. 11 refs., 3 figs., 3 tabs.

12661 (SIEMENS-KWU-B–33/90/0808) **Fuel recycling in boiling water reactors. Final report.** Uckert, J.; Bender, D.; Kaas, P.; Lembcke, R.; Misu, S. Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1990. 72p. (In German). Contract BMFT KWA 77047. Order Number DE91754712. Source: OSTI; NTIS (US Sales Only); INIS.

The present study confirms the feasibility of inserting mixed-oxid-fuel assemblies (MOX-FA) in boiling-water reactors in conjunction with reactivity-equivalent uranium-fuel assemblies. First, the established calculation methods were extended according to the specific MOX-uranium mutual interaction effects. Then, typical bundle-structures were analysed according to their neutron-physical features. The reactor-simulations show a non-critical behaviour with respect to limiting conditions and reactivity control. The variation of the isotopic composition and the plutonium content with its effects on the physical features was considered. (orig.) With 6 refs., 3 tabs., 29 figs.

12662 (SV-S–90-5) **Numerical modelling of two-phase flow in the upper plenum of a BWR by a three dimensional two-fluid model.** Hemstroem, B.; Tinoco, H. Swedish State Power Board, Aelvkarleby (Sweden). 14 Jun 1990. 11p. (CONF-9009342–: International symposium on engineering turbulence modelling and measurements, Dubrovnik (Yugoslavia), 24-28 Sep 1990). Order Number DE91623404. Source: OSTI; NTIS (US Sales Only); INIS.

High moisture contents in the steam to the turbines have been detected in the nuclear power plants at Forsmark, Sweden. The origin of the problem has been located to the steam separators, which work adequately only for a fairly narrow range of moisture contents. Thus, a rather complete information of the two-phase flow field in the upper plenum is needed in order to determine the performance of each individual steam separator. A viable alternative to obtain the necessary information is a numerical study. Therefore, a three-dimensional numerical model of the upper plenum has been developed. The model is complemented with empirical correlations based on experimental data to simulate the behaviour of the steam separators. The necessary inlet boundary conditions are given by the results obtained with the POLCA code for simulation of core dynamics. The fluid dynamics of the two-phase mixture in the upper plenum is modelled using the two-fluid model, with steam as continuous phase and water droplets as dispersed. The corresponding equations of motion have been solved by means of the PHOENICS code. As a result of the calculations, the different mass flow rate to the separators are obtained. The carry-over from each separator is then obtained form the mass flow rates and empirical correlations for the separation performance. The present results show a tendency of the phase to separate, giving an increased concentration of water at the periphery, with a corresponding increase of the void at the central region of the moderator tank. This effect produces a shift in the moisture content of the steam to the separators, away from the mean nominal value, deteriorating their performance. It is concluded that separators with better characteristics are needed in order to lower the moisture content of the steam to the turbines.

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Refer also to citation(s) 12490, 12504, 12657, 12658, 12659, 12660, 12760, 12799, 12801, 12808, 12845, 12857, 12858, 12859, 12861, 12862, 12864, 13230

12663 (CEA-CONF–10410) **Fiber optic components compatibility with the PWR containment radiation field.** Breuze, G.; Serre, J. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire. 1990. 20p. (CONF-9004285–: IAEA Specialists' Meeting on Communication and Data Transfer in Nuclear Power Plants,

Lyon (France), 24-26 Apr 1990). Order Number DE91752722. Source: OSTI; NTIS (US Sales Only).

Present and future applications of fiber optics transmission in the nuclear industrial field are emphasized. Nuclear acceptance criteria for relevant electronic equipments in terms of radiation dose rate, integrated dose and required reliability are given. Ambient conditions of PWR containment are especially considered in the present paper. Experimental results of optical fibers and end-components exposed to ^{60}Co gamma rays are successively shown. Main radiation response characteristics up to 10^4 Gy (with dose rates of about 100 $Gy.h^{-1}$) of both multimodal fiber families (step index and gradient index fibers) are compared. Predominant features of pure silica core fibers are: * an efficient photobleaching with near IR light from LED and LD commonly used in transmission data links, * a radiation hardening reducing induced losses down to 10 $dB.km^{-1}$ in fine fibers up to date with latest developments. Dose rate effect on induced losses is also outlined for these fibers. Optoelectronic fiber-end components radiation response is good only for special LED (AsGa) and PD (Si). Radiation behavior of complex pigtailed LDM (laser diode + photodiode + Peltier element + thermistor) is not fully acceptable and technological improvements were made. Preliminary results are given. Two applications of fiber links transmitting data in a PWR containment and a hot cell are described. Hardening levels obtained and means required are given.

12664 (CEA-DAS–731) **The french 900 MWe PWR PSA results and specificities.** Lanore, J.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 6p. (CONF-9009346–: Committee on the Safety of Nuclear Installations (CSNI) on Probabilistic Safety Assessment (PSA) applications and limitations, Santa Fe, NM (USA), 4-6 Sep 1990). Order Number DE91752701. Source: OSTI; NTIS (US Sales Only).

A probabilistic Safety Assessment has been performed by the Safety Analysis Department of CEA for a 900 MWe standardized plant. The paper presents the objectives, the scope of the study and the level 1 results. Some general insights are drawn, especially the benefit related to the implementation of emergency procedures and the importance of risk during shutdown situations.

12665 (CEA-DAS–740) **Early localization of containment leakage during an accident.** Pepin, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Chauliac, C.; Libmann, M.; Martinez, J.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 12p. (CONF-901024–: 2. international conference on containment design and operation, Toronto (Canada), 14-17 Oct 1990). Order Number DE91757104. Source: OSTI; NTIS (US Sales Only).

In case of an accident in a nuclear plant, checking the containment leaktightness would be a fundamental step for the diagnosis and prognosis of the radiological consequences. Significant help in this task can be provided by softwares. For that purpose, the French Atomic Energy Commission (CEA) is developing an expert system which can provide early in the accident a classification of the possible leakage paths and help understanding the necessary corrections which have to be undertaken by the utility. This software will be used at the Emergency Technical Center of the CEA. Its basic principles are described in this paper.

12666 (CEA-DAS–742) **The application of redundancy-related basic safety principles to the 1400 MWE reactor core standby cooling system.** Bertrand, R. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 33p. (CONF-9009361–: Commission of the European Communities Working Group on the Safety of Thermal reactors, Brussels (Belgium), 26-27 Sep 1990). Order Number DE91757102. Source: OSTI; NTIS (US Sales Only).

This memorandum shall provide the background for the work of the European Community Commission which is to analyze safety principles relating to redundancy. The redundancy-related basic safety principles applied in French nuclear power plants are the following: . the single-failure criterion, . provisions additional to application of the single-failure criterion. These are mainly provisions made at the design stage to minimize risks associated with common cause failures or the risks of human error which can lead to such failures: - protection against hazards of internal and external origin, - the geographical or physical separation of equipment, - the independence of electrical power supplies and distribution systems, - the additional resources and associated operating procedures making it possible to accommodate total loss of the safety systems. The scope also includes the operating rules which ensure availability of redundant safety-related equipment. The provisions relating to the single-failure criterion are detailed in Basic Safety Rule 1.3.A appended. The application of these principles proposed by the operating organization and accepted by the safety authorities for the design and operation of the standby core cooling system (System RIS) is explained.

12667 (CEA-DAS–743) **Evaluation of the reliability of the protection system of 1300 MWE PWR'S.** Blin, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire). CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 13p. (CONF-9010333–: IAEA specialists meeting on analysis and experience in control and instrumentation, Arnhem (Netherlands), 16-19 Oct 1990). Order Number DE91757105. Source: OSTI; NTIS (US Sales Only).

An assesment of the reliability of the Digital Integrated Protection System (SPIN) of the 1300 MWe type french reactors has been carried out by treating an example: the emergency shutdown, which can be called upon by several initiating events. The whole chain, from sensors to breakers and control rods, is taken into account. The reliability parameters used for the quantification are evaluated essentially from the experience feedback of french reactors. The not wellknown parameters being the common cause failure rates of electronic components and the efficiency rate of the self-tests, the results of the study are then presented in a parametric form, according to these two factors.

12668 (CEA-DAS–745) **SIPA, a PWR simulator for post-accident training and studies.** Peltier, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. d'Analyse de Surete); Poizat, F. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 5p. (CONF-900980–: 3. ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century, Lyon (France), 23-28 Sep 1990). Order Number DE91757101. Source: OSTI; NTIS (US Sales Only).

SIPA (Simulator for Post-Accident conditions) which is now under development will be operated by EDF and CEA. Each organization will have its own version, SIPA 1 for EDF and SIPA 2 for CEA. The three main purposes will meet the needs of EDF and CEA as described below: - training of the EDF's ISR (Ingenieurs de Surete et Radioprotection = Shift Safety Advisors) which needs physical relevance, real time during accidental transients and visualisation of two-phase flow phenomena to well understand what could physically happen. - studies for EDF's designs which require calculation of a lot of points or scenarios. Quality Assurance of the models and data package, interactivity for procedure finalisation, availability of resources to all engineers, and possibility of creation of new models, - safety analysis requirements for CEA/IPSN (technical support of the French safety authority, the Central Service for the Safety of Nuclear Installations) which includes the actual safety analysis (analysis of procedures, design basis accidents, probabilistic safety analysis, real incidents studies, reactor tests...), the preparation and the execution of safety drills and training of engineer analysts.

12669 (CEA-DAS–746) **Probabilistic safety study of 900 MWE PWR'S.** Brisbois, J.; Lanore, J.M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 4p. (CONF-900980–: 3. ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century, Lyon (France), 23-28 Sep 1990). Order Number DE91757103. Source: OSTI; NTIS (US Sales Only).

A probabilistic Safety Assessment has been performed by the Safety Analysis Department of CEA for 900 MWe standardized plant. The paper presents the objectives, the scope of the study and the level I results. Some general insights are drawn, especially the benefit related to the implementation of emergency procedures and the importance of risk during shutdown situations.

12670 (DOE/ET/34212–57) **Poolside examination of gadolinia lead test assemblies after three cycles of irradiation.** Newman, L.W. (B and W Fuel Co., Lynchburg, VA (USA)); Mayer, J.T.; Papazoglou, T.P.; Pyecha, T.D. B and W Fuel Co., Lynchburg, VA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div. Dec 1990. 105p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-78ET34212. (BAW–2124). Order Number DE91007935. Source: OSTI; NTIS (US Sales Only): GPO Dep.

The Babcock & Wilcox Company, Duke Power Company, and The United States Department of Energy participated in an extended burnup project that irradiated and examined an advanced fuel assembly design from pressurized water reactors. This advanced fuel assembly used a UO_2-Gd_2O_3 fuel and burnable absorber mixture along with other design features that enhance fuel performance and uranium utilization such as annular pellets, annealed guide tubes, Zircaloy intermediate grids, and a removable upper end fitting. The goal of the project was to extend the burnup of pressurized water reactor fuel assemblies to a batch-average burnup of 50,000 MWd/mtU. To achieve this goal, five lead test assemblies were designed, manufactured, characterized, and inserted for irradiation in Oconee Unit 1 cycle 8. One lead test assembly received a burnup of 13,900 MWd/mtU by its discharge at the end of cycle 88; the remaining four received a burnup of 16,000 MWd/mtU. Of the four remaining lead test assemblies, three received burnups of approximately 45,000 MWd/mtU by their discharge at the end of cycle 10. The fourth lead test assembly received approximately 58,300 MWd/mtU when discharged at the end of cycle 11. To track the performance characteristics of the advanced assemblies, nondestructive examinations at poolside were conducted. This report contains the data collected during the poolside examination of the lead test assemblies after three cycles of irradiation. 63 refs., 50 figs., 19 tabs.

12671 (DOE/NE/34082–T3) **Fast fluxes and fluences of the TRIBULATION fuel rods during their irradiation in the BR3 core: TRIBULATION Project.** Brusselaers, P. Belgonucleaire SA, Brussels (Belgium). Jan 1989. 73p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–89/77). Order Number DE91008289. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides fast flux and fluence information relative to the irradiation of the TRIBULATION rods in BR3 cycles 4A, 4B, 4C, 4D1 and 4D2. Fast fluxes and fast fluences are given for each rod of each group of the test matrix, and the geometrical layout (12 axial nodes) is provided. For each cycle, according to each group, the information is given as follows: axial fast flux distribution at nominal power (100% N_p), and axial fast fluence distribution. 2 figs., 66 tabs.

12672 (DOE/NE/34082–T6) **BR3 second phase irradiation data and nondestructive examinations of BN2 fuel rods Nos. 7 and 8: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Sep 1984. 67p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–84/36). Order Number DE91008292. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: re-irradiation of two experimental fuel rods from group BN2, in the BR3 reactor at Mol – Belgium of which one underwent a fast operational transient in the BR2 reactor; and nondestructive examinations at Mol – Belgium of these two fuel rods from group BN2. The group BN2 includes the fuel rods 5 to 8 of the test matrix. 6 refs., 19 figs., 30 tabs.

12673 (DOE/NE/34082–T7) **Post-irradiation examination of ten BR3 fuel rods comprising the first part of the TRIBULATION Programme: TRIBULATION Project.** Garlick, A. (UKAEA Headquarters, London (UK)); Goldsmith, L.A.; Kennedy, P.D.; Mellor, P.; Thompson, J.F.W.; Walters, C.L. Belgonucleaire SA, Brussels (Belgium). Jul 1986. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–85/38). Order Number DE91008293. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes post-irradiation examination at WNL of 10 fuel rods from the TRIBULATION programme. The rods had been irradiated to 20–40 GWd/tU in the BR3 PWR and following this 5 of the rods had been subjected to power transients in the BR2 MTR. The rods are of standard BR3 dimensions (1131mm long, 9.50mm nominal diameter). Fabrication data have been reported and are summarized. Irradiation histories are also presented. Details are given of the results of non-destructive testing of all 20 rods (except that diameter measurements were made on only 6 rods) and of the destructive examinations of 4 selected rods. 9 refs., 23 figs., 18 tabs.

12674 (DOE/NE/34082–T10) **BR3 first phase irradiation data and intermediate examinations of FGA2 fuel rods: TRIBULATION Project.** Blanpain, P. Belgonucleaire SA, Brussels (Belgium). Apr 1984. 137p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–84/34). Order Number DE91008296. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the informations relative to the irradiation conditions of the experimental fuel rods, filled with annular pellets, of the FGA2 group in cycles 4B and 4C of the BR3 reactor at Mol – Belgium and the results of the intermediate non- destructive examinations of the six fuel rods of the group. The group FGA2 of the TRIBULATION program includes the fuel rods 35 to 40 of the test matrix. All those six rods have been examinated after the BR3/4C cycle. Among them, the rod 35 will undergo destructive examinations; the rods 36 and 37 will be submitted to transient tests in the BR2 reactor and after that, the rods 37 to 40 will pursue their irradiation in the BR3/4D cycle. 8 refs., 46 figs., 75 tabs.

12675 (DOE/NE/34082–T13) **Fabrication and characterization of FRAGEMA design fuel rods (annular pellets): TRIBULATION Project.** Floze, J.C. (Fragema, 69 - Lyon (France)). Belgonucleaire SA, Brussels (Belgium). Feb 1984. 53p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–84/25B). Order Number DE91008299. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents the fabrication and characterization of 6 FRAGEMA-design fuel rods supplied to the TRIBULATION Project (TRIBULATION matrix; numbers 35 to 40). Fuel rods being supplied to the TRIBULATION Project were initially designed and characterized for an irradiation program in BR3 reactor in Mol (Belgium). These rods are essentially FRAGEMA 17 x 17 design. The exceptions are as follows: fuel rod length and rod free volume (for compatibility with BR3 fuel assemblies); plenum length; initial U_{235} enrichment; annular pellets; and the top and bottom end plugs (BR3 design). The identification of the 6 FGA fuel rods (annular pellets) supplied to the TRIBULATION Project are indicated. The 6 fuel rods were removed from two assemblies respectively C7 and C8 at the end of cycle BR3/4C. The rods initially pressurized with helium to 31 bar relative had an initial enrichment of 3.1% U235. 15 figs., 15 tabs.

12676 (DOE/NE/34082–T14) **Nondestructive examinations of BN1 fuel rods after fast operational transients in BR2: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Aug 1984. 51p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–84/26). Order Number DE91008300. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report (ref. TR 84/26) provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: fast operational transients on two experimental fuel rods from group BN1, in the BR2 reactor at Mol – Belgium; and intermediate examinations at Mol – Belgium of these two fuel rods from group BN1 after transient. The group BN1 includes the fuel rods 1 to 4 of the test matrix. For these four fuel rods, details on irradiation history and nondestructive post-irradiation examinations before transient testing. 2 refs., 20 figs., 12 tabs.

12677 (DOE/NE/34082–T15) **Nondestructive examinations of BN2 fuel rods after fast operational transients in BR2: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Aug 1984. 50p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–84/27). Order Number DE91008301. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the

TRIBULATION programme: Fast operational transients on two experimental fuel rods from group BN2, in the BR2 reactor at Mol –Belgium; and intermediate examinations at Mol – Belgium of these two fuel rods from group BN2 after transient. These activities refer to irradiation simulating transient conditions in the BR2 reactor and subsequent non-destructive testing of the experimental PWR fuel rods. The group BN2 includes the fuel rods 5 to 8 of the test matrix. For these four fuel rods, details on irradiation history and non-destructive post-irradiation examinations before transient testing are given. 3 refs., 19 figs., 12 tabs.

12678 (DOE/NE/34082–T18) **BR3 first phase irradiation data and intermediate examinations of W2 fuel rods: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Sep 1982. 118p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–82/15). Order Number DE91008304. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: pre-irradiation of experimental fuel rods, group W2, in the BR3 reactor at Mol – Belgium; and interim examinations at Mol – Belgium of pre-irradiated fuel rods, group W2. The group W2 includes the fuel rods 16, 17, 18, 19, 20 and 21 of the test matrix. For these six rods, one provides in the present report, details on irradiation history and non destructive post-irradiation examinations. 7 refs., 48 figs., 52 tabs.

12679 (DOE/NE/34082–T19) **BR3 first phase irradiation data and intermediate examinations of W1 fuel rods: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Sep 1982. 79p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–82/14). Order Number DE91008305. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the Tribulation Program: pre-irradiation of experimental fuel rods, group W1, in the BR3 reactor at Mol – Belgium; and interim examinations at Mol – Belgium of pre-irradiated fuel rods, group W1. The group W1 includes the fuel rods 9, 10, 11 and 12 of the test matrix. For these four rods, one provides in the present report details on irradiation history and non destructive post-irradiation examinations. 8 refs., 32 figs., 31 tabs.

12680 (DOE/NE/34082–T21) **Fabrication and characterization of Westinghouse-design fuel rods: TRIBULATION Project.** Patterson, L.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Belgonucleaire SA, Brussels (Belgium). Mar 1983. 78p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–83/22). Order Number DE91008307. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents the fabrication and characterization of 17 Westinghouse-design fuel rods supplied for the Tribulation Program. Fuel rods being supplied to the Tribulation Program were initially designed and characterized for a Westinghouse ramp program. The rods were specifically intended for preirradiation in the BR-3 reactor and subsequent ramp testing in a reactor test loop. The 17 x 17 fuel rod diameter Core 4A BR-3 fuel assembly configuration was designed for removal of all 28 fuel rods and reconstitution of the assembly for subsequent irradiation cycles. The fuel was also characterized during fabrication to provide a well-defined base point for subsequent evaluation of power ramp performance. The initial Westinghouse ramp program was begun in 1974; fuel rods were fabricated in 1975 and loaded into assemblies in 1976. Irradiations began in mid-July 1976. The rods are essentially the Westinghouse 17 x 17 design; the exceptions are as follows: initial U-235 enrichment (5.74 and 8.26 w/o, for compatibility with BR-3 nuclear requirements); level of fuel rod helium prepressurization; fuel rod length and rod free volume; pressurization hole in bottom end plug rather than top. The top end plug was modified for the removable concept; tritium getters in several rods.

12681 (DOE/NE/34082–T24) **Intermediate neutronic report after the W3 rods irradiations in the BR3/4C cycle: TRIBULATION Project.** Maldague, T. Belgonucleaire SA, Brussels (Belgium). Aug 1986. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–86/51). Order Number DE91008310. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Four W3 rods were irradiated in the second half of the cycle 4C. They were previously irradiated in the cycles BR3/4A and BR3/4B. The irradiation history of these rods in the previous cycles is presented in this document. During core 4C, they were irradiated in the assemblies W1RR and W3RR. The positions of these assemblies in the core are provided. 1 ref., 5 figs., 18 tabs.

12682 (DOE/NE/34082–T25) **Intermediate neutronic report after the W1 rods irradiations in the BR3/4C cycle: TRIBULATION Project.** Maldague, Th. Belgonucleaire SA, Brussels (Belgium). Aug 1986. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–86/50). Order Number DE91008311. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Four W1 rods were irradiated in the second half of the cycle 4C. They were previously irradiated in the cycle BR3/4A. The irradiation history of these rods in the previous cycle is provided. During core 4C, they were irradiated in the assemblies W1RR and W3RR. The positions of these assemblies in the core are given. The locations of the rods in the assemblies is also provided. 1 ref., 5 figs., 18 tabs.

12683 (DOE/NE/34082–T26) **Nondestructive examinations of FGA1 fuel rods after fast operational transients in BR2: TRIBULATION Project.** Blanpain, P. Belgonucleaire SA, Brussels (Belgium). Feb 1985. 62p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–85/41). Order Number DE91008312. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made within the framework of the TRIBULATION program: fast operational transients on three fuel rods from group FGA1, in the BR2 reactor at Mol-Belgium; and intermediate non-destructive examinations of these fuel rods at Mol-Belgium. The group FGA1 includes the fuel rods 29 to 34 of the test matrix. The present report concerns only the fuel rods 30, 31 and 32, which underwent a transient test and second series of non-destructive examinations. A diagram of the FGA1 fuel rod identification, irradiation and examinations performed to date, as well as the rod destination is provided. The BR3 irradiation histories and the transient conditions of the three fuel rods are summarized. 7 refs., 33 figs., 11 tabs.

12684 (DOE/NE/34082–T28) **Fast operational transients in BR2: Part 1: TRIBULATION Project.** Nackaerts, H. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Belgonucleaire SA, Brussels (Belgium). Feb 1983. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–83/21). Order Number DE91008321. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The TRIBULATION program was set up to study the PWR fuel behavior at high burnup in case an earlier accidental transient has occurred in the power plant. The program was proposed to the international nuclear community in October 1979 by SCK/CEN and BelgoNucleaire. Since then some 20 organizations (fuel vendors, utilities as well as national laboratories) have decided to participate in the program. The TRIBULATION program includes 48 fuel pins (figure 1), with various design or fabrication parameters divided in subgroups of typically 4 identical pins. This report deals with the fast operational transients in BR2 of the first part of the program. This document, Part 1, contains fuel pins 1 to 28 of the TRIBULATION matrix. Thirteen of these 28 fuel pins have been submitted to a transient. The different installations and the transient procedures are described, and the results of the transients reported. 15 refs., 68 figs.

12685 (DOE/NE/34082–T30) **Final nondestructive examinations on FGA2 fuel rods after irradiation in BR3/4D_2 core: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Aug 1988. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–88/71). Order Number DE91008323. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the results of the final nondestructive examinations performed on four experimental fuel rods of the FGA2 group. The FGA2 group includes the fuel rods 35 to 40 of

the test matrix. A diagram of the FGA2 fuel rod identification, irradiations and examinations performed within the framework of the TRIBULATION program is provided. This report only concerns rods 37 to 40 which have been submitted to a last irradiation phase during BR3/$4D_2$ cycle, and to subsequent nondestructive examinations. 8 refs., 32 figs., 10 tabs.

12686 (DOE/NE/34082–T31) **Destructive examination results (puncture) of fuel rods BA341 (33), BE393 (37), T1502 (42), T1504 (44), T2606 (46), T2607 (47) and T2608 (48): TRIBULATION Project.** van de Velde, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Belgonucleaire SA, Brussels (Belgium). Oct 1989. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–89/83). Order Number DE91008324. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report describes the destructive examination (puncture) of fuel rods in the Tribulation Program. The accuracy and results of the gas analysis are provided. 5 tabs. (FI)

12687 (DOE/NE/34082–T32) **Destructive examinations on the FGA1 and FGA2 fuel rods Nos. 31, 32, 38 and 39 of the TRIBULATION Programme: TRIBULATION Project.** Reindl, J. (Swiss Federal Inst. for Reactor Research, Wuerenlingen (Switzerland)); Bachli, A.; Erne, A.; Hofer, R.; Linder, H.P.; Petrik, F. Belgonucleaire SA, Brussels (Belgium). Jan 1990. 39p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–90/84). Order Number DE91008325. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Within the framework of the TRIBULATION programme, 4 irradiated UO_2 rods of the Belgian nuclear power station BR-3 resp. BR-2 (transient) were delivered to PSI-Wuerenlingen for destructive examination on June 88. The delivery contained 2 rods BA 355 and BA 356 with solid pellet and two rods BE 394 and BE 385 with annular pellets, which have been irradiated in Mol up to a max. peak pellet burn-up of 56,8-65,3 GWd/tM. The PSI-Hot Laboratory carried out the following examinations according to the PIE contract: puncture and fission gas analysis; burn-up determination and isotope analysis; fuel ceramography and cladding metallography; and alpha and beta/gamma autoradiography. The results of each examination are described in the following tables and important pictures of the ceramography and metallography are presented. 7 refs., 17 figs., 6 tabs.

12688 (DOE/NE/34082–T34) **Postirradiation examination of rod T1503 comprising Task 4 of the TRIBULATION Project: TRIBULATION Project.** Manley, A.J. (UKAEA Headquarters, London (UK)); Kennedy, P.D.; Scogings, B.C.; Thompson, J.F.W. Belgonucleaire SA, Brussels (Belgium). Feb 1989. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–89/80). Order Number DE91008327. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Phase 4 of the post-irradiation examination of fuel rods irradiated as part of the TRIBULATION project involves 1 rod. The rod identification and its nominal pre-irradiation characteristics are presented and the irradiation history provided. This rod was subjected to a transient, the details of which are given. This memorandum details the metrology, gamma-scanning, eddy-current test and gas release results obtained on this rod and the results of ceramographic and metallographic examinations. 6 figs., 8 tabs.

12689 (DOE/NE/34082–T35) **Post-transient destructive examinations of fuel rods T1502 and T2606: TRIBULATION Project.** Sannen, L.; van de Velde, J.; van Loon, C. Belgonucleaire SA, Brussels (Belgium). Jan 1989. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–89/74). Order Number DE91008328. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report describes the destructive examination (puncture) of fuel rods in the Tribulation program. The accuracy and results of the gas analysis are provided. (FI)

12690 (DOE/NE/34082–T41) **Intermediate nondestructive examinations of the BBR1 fuel rods after their first irradiation phase; fast operational transient on rods 42 and 43 and subsequent nondestructive examinations: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 70p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–87/63). Order Number DE91008334. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: recall of the irradiation conditions of cycles 4C and $4D_1$ of the BR3 reactor and results of the non destructive examinations performed after cycle $4D_1$; short description of the fast operational transient in the BR2 reactor at Mol-Belgium; and results of the subsequent non destructive examinations. The group BBR1 includes the fuel rods 41 to 44 of the test matrix. The initial enrichment was 3.19 w/o U5. The four rods underwent their first irradiation phase in cores 4C and $4D_1$ of the BR3 reactor. Two of them, numbers 42 and 43 of the test matrix, were then submitted to a fast operational transient in the BR2 reactor. The BBR1 campaign continues with a second irradiation of rods 43 and 44 in cycle $4D_2$ of the BR3 reactor, the rods 41 and 42 being destructively examined. 7 refs., 41 figs., 13 tabs.

12691 (DOE/NE/34082–T45) **Intermediate nondestructive examinations of FGA1 fuel rod No. 31 after irradiation in BR3/$4D_1$ core; Fast operational transient in BR2 and subsequent nondestructive examinations: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 43p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–87/61). Order Number DE91008338. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: Recall of the irradiation conditions in core $4D_1$ of the BR3 reactor and results of the non destructive examinations performed after cycle $4D_1$; short description of the fast operational transient in the BR2 reactor at Mol – Belgium; and results of the subsequent non destructive examinations. The FGA1 group includes the fuel rods 29 to 34 of the test matrix. The six rods were filled with standard pellets enriched to 4.95 w/o U5. The present report only concern rod BA355, No. 31 in the TRIBULATION matrix. Rods 32, 33, and 34 which were also irradiated in core $4D_1$ of the BR3 reactor, have not been submitted to postirradiation examinations nor to transient test. The four remaining FGA1 fuel rods (31 to 34) pursue their irradiation in cycle $4D_2$ of the BR3 reactor. 10 refs., 19 figs., 9 tabs.

12692 (DOE/NE/34082–T46) **Intermediate nondestructive examinations of FGA2 fuel rod No. 38 after irradiation in BR3/$4D_1$ core; Fast operational transient in BR2 and subsequent nondestructive examinations: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 44p. Sponsored by USDOE,. DOE Contract FG01-82NE34082. (TR–87/62). Order Number DE91008339. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: recall of the irradiation conditions in core $4D_1$ of the BR3 reactor and results of the nondestructive examinations performed after cycle $4D_1$; short description of the fast operational transient in the BR2 reactor at Mol – Belgium; and results of the subsequent non destructive examinations. The FGA2 group includes the fuel rods 35 to 40 of the test matrix. The six rods were filled with annular pellets enriched to 3.1 w/o U5. The present report only concerns rod BE394, No. 38 in the TRIBULATION matrix. Rods 37, 39, and 40 which were also irradiated in core $4D_1$ of the BR3 reactor, have not been submitted to postirradiation examinations nor to transient test. The four remaining FGA2 fuel rods (37 to 40) pursue their irradiation in cycle $4D_2$ of the BR3 reactor. A diagram of the FGA2 fuel rod identification, irradiations and examinations preformed to date is provided. 10 refs., 20 figs., 9 tabs.

12693 (EUR–12781) **Structural reliability benchmark exercise for primary circuit components life prediction methods.** Vagner, J.; Aubert, C. Commission of the European Communities, Luxembourg (Luxembourg). May 1990. 16p. Contract No. 2959-86-06 ELISPF. Source: OSTI; NTIS (US Sales Only).

The growth of a defect, designedly placed in a reactor vessel mockup subjected to a cyclic pressure has been numerically simulated and compared to non destructive examinations. This comparison emphasizes the necessity of taking into account the

initiation phase and the residual stresses to yield a satisfactory growth prediction.

12694 (EUR–12782) **Analysis of the ECN Petten 36 rod bundle and Reflood experiments with the RELAP5/MOD2 computer code.** Lorenzini, E. (Bologna Univ., (IT)); Orlandelli, C.M.; Spiga, M.; Corticelli, M.A. Commission of the European Communities, Luxembourg (Luxembourg). May 1990. 133p. Contract No. 3149-87-05 ELISPI. Source: OSTI; NTIS (US Sales Only).

This paper reports the calculation of 36-ROD bundle reflood experiments of ECN research. The ECN 36-ROD bundle tests, performed with axial uniform power profile, are reflood experiments at 0.2 MPa pressure executed for different conditions. The series of tests yield a data base suitable for code validation and development. After a brief description of the ECN plant and test section, the comparison between the experimental data and the results of calculations, performed by RELAP5/MOD2 computer code, is discussed.

12695 (EUR–12883) **Inner tubes cutting method by electrical arc saw.** Thome, P. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 48p. (In French). Contract no FI1D-0009. Source: OSTI; NTIS (US Sales Only).

The research program deals on the definition of tools used for dismantling steam generator tubes bundle of PWR and on tool used for cutting pipes of great diameter by using the process of cutting by electrical arc saw. The remote tools are used for cutting by the interior pipes of contamined circuits.

12696 (IAEA-TECDOC–577, pp. 113-123) **Czechoslovak activity in the nuclear fuel domain.** Bardos, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Hron, M.; Drexler, J.; Vesely, P. International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

In the period of searching for the most advantageous type of a nuclear power reactor suited to industrial applications in CMEA countries, CSSR concentrated, owing to the international division of work principles valid at that time, almost exclusively on the HWGCR reactor. In CSSR, a prototype of the reactor in question with a capacity of 150 MW was implemented, the manufacture of this type mastered and the necessary organizational and technical background for managing and ensuring nuclear fuel industrial manufacture relative to the reactor type developed created. Evidently, this development and the modifications in the nuclear power industry orientation affected significantly the aims in the domain of research, development and implementation of the nuclear research work effected. (author). 6 refs, 3 tabs.

12697 (INIS-mf–12781) **Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.** Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Volume II of the proceedings contains full texts of 32 contributions, all of which fall within the INIS subject scope. The conference was organized to facilitate exchange of knowledge and experience between Czechoslovak organizations engaged in the State Research Project "Nuclear Power Facilities with 1000 MW Light-Water Reactors" and domestic suppliers of the requisite equipment. (Z.M.). 45 figs., 9 tabs., 201 refs.

12698 (INIS-mf–12781, pp. 11-14) **Neutron physics calculations of WWER-1000 reactor cores.** Dach, K. et al. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The major problems of neutron physics calculations of the WWER-1000 reactor core in Czechoslovak conditions are discussed. The main obstacle consists in the absence of a library of diffusion data requisite for calculations pertaining to the three-year fuel cycle. Data for the two-year cycle, which are available, are not accurate and precise enough to assure a sufficient accuracy of the theoretical analysis. Reliable data which could be employed for diffusion constant correction, such as the experimental power distributions, reactivities, reactivity coefficients, etc., are also lacking. No programs exist for the design and optimization of fuel shifting in WWER-1000 reactor core conditions. Similar programs for the WWER-440 reactor fail, e.g., to address the problem of the amount and location of the burning-up absorbers. (Z.M.).

12699 (INIS-mf–12781, pp. 48-53) **Computer programs in reactor physics and nuclear unit dynamics, used in developmental measurements.** Jurecka, J. et al. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Computer programs for problem solving in the field of reactor core physics and the dynamics of transients, developed particularly for the Temelin nuclear power plant start-up, are briefly characterized. Attention is paid to the basic features and approaches to the solution with respect to adaptation of these programs to the PC basis. The underlying principles and approaches to the interpretation of the results are outlined. Among others, a program SIDY is being developed for solving transients, based on a nonlinear mathematical and physical model of the unit. For this purpose, the unit is divided into a system of computation sections with concentrated parameters. The program SIDY has been set up in FORTRAN 77 for IBM-standard PC's. With regard to the demands and size of the program, on-line data processing is not planned. (Z.M.). 7 refs.

12700 (INIS-mf–12781, pp. 15-22) **Checking earthquake resistance of feedwater pump.** Dohnal, M. (Sigma, Olomouc (Czechoslovakia). Vyzkumny Ustav Cerpacich Zarizeni, Potrubi a Armatur). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The dynamic behavior of rotors of feedwater pumps for WWER-1000 nuclear power plants was analyzed with respect to seismic excitation. Mathematical determination of the transient state and of the maximum amplitude of the forced rotor vibration is described in detail. The results of the analysis give evidence that the pump rotor is earthquake-resistant. Its first critical revolutions of bending-circulation oscillations have a value of 75 Hz, which is well above the seismic excitation band. The forced vibration amplitude does not exceed the value of 0.02 mm, which is lower than the clearance of the runner packing rings. (Z.M.). 4 figs., 5 refs.

12701 (INIS-mf–12781, pp. 31-35) **R+D programme of Czechoslovak suppliers of nuclear power plant equipment.** Fenyk, J. et al. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The main tasks of Czechoslovak manufacturers and suppliers of machinery and electrotechnical equipment for nuclear power plants are briefly characterized with respect to requirements for R+D activities. This concerns particularly the start-up of unit 1 of the Temelin nuclear power plant and construction of units 3 and 4 of this plant, which should be done following an improved WWER-1000 design, viz. the so-called Design 88. Moreover, a new WWER-1000 pressurized water unit design (Design 92) should be worked out. In particular, it is required that nuclear safety of the nuclear power plant equipped with reactors of this type be increased as much as by 3 orders of magnitude; this will call for a fundamental upgrading of the plant control system. Considerations for the future also include the development of an up-to-date WWER-500 medium-power pressurized water unit that could also produce heat for district heating purposes. (Z.M.).

12702 (INIS-mf–12781, pp. 7-10) **In-service chemical diagnostics of WWER-1000 steam generator.** Cervinka, J. et al. (Vyzkumny Ustav Energetickych Zarizeni, Brno (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A chemical diagnostics subsystem is proposed for WWER-1000 steam generators. It consists of two parts. The analytical module serves indirect examination of the effect of the water chemistry of the steam generator secondary side on the structural materials involved. Samples are analyzed for the presence of corrosion-aggressive substances, which can cause or accelerate corrosion damage, and of corrosion products. The quantities measured include electrolytic conductance, pH value, redox potential and oxygen content and concentrations of selected anions. The other part of the chemical diagnostics subsystem provides direct measurement of the degree of salt concentration in the steam generator water by means of microconductivity sensors. Each steam generator should be equipped with three sensors. (Z.M.). 2 figs.

12703 (INIS-mf–12781, pp. 54-58) **Thermohydraulic calculations of WWER-1000 reactor core and fuel assembly.** Juzova, Z. (Skoda, Plzen (Czechoslovakia)); Kostalek, J. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

An account is given of the results of development of the program complex CALOPEA, designed for thermohydraulic calculations of the WWER-1000 reactor core and fuel assembly by the subchannel analysis method. The programs are briefly described and the results obtained are demonstrated. (author). 3 figs., 4 refs.

12704 (INIS-mf–12781, pp. 59-64) **Development and introduction of manufacture of WWER-1000 linear stepping drive.** Kott, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Kocandrle, L.; Wagner, K.; Haniger, L.; Elger, R.; Zdebor, J. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A new position indicator was developed for the linear stepping motor driving the control elements of WWER-1000 reactors. The linear motor is pawl type, with a step of 20 mm. The new position indicator involves a sensor which is located in the rector pressure vessel and is formed by eight single-winding coils for operating temperatures up to 340 degC. The coils are accommodated in a pressure tube 18/13 mm in diameter, which is rated for a full external test overpressure of 25 MPa and, in case of failure, additionally secured by a bushing rated for this overpressure as well. Signals from the sensor are transmitted through six wires to two independent position indicators, viz. a main one and a standby one. (Z.M.). 3 figs.

12705 (INIS-mf–12781, pp. 65-68) **Implementation of RELAP computer program.** Krizek, P. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The program RELAP4/MOD6 is a tool for computer analysis of the thermodynamic phenomena occurring in system I of a pressurized water reactor during a loss-of-coolant accident. It is reported on how the program was obtained, implemented on an EC 1035 computer and tested during an experiment at KFKI in Budapest, as well as on the experience gained with it and prospects of its future application. (author). 6 refs.

12706 (INIS-mf–12781, pp. 69-71) **Development of diagnostic tests of WWER-1000 primary circuit components.** Majer, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

R+D activities concerning the main circulation pump diagnostic system for WWER reactors are briefly characterized. Attention is paid to vibration tests, tests associated with the localization and evaluation of loose parts, and to problems of complex diagnostics of the main circulation pump. Based on the work done, it will be possible to incorporate the main circulation pump diagnostic system into the complex system of operation diagnostics of the Temelin nuclear power plant. (Z.M.).

12707 (INIS-mf–12781, pp. 72-75) **Reliability analysis of secondary circuit of WWER-1000 nuclear power plant.** Marko, M. (Vyzkumny Ustav Energeticky, Tanvald (Czechoslovakia)); Fuchs, P. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The goals of the reliability analysis of a WWER-1000 secondary circuit scheduled for 1986 to 1990 are outlined, the procedures are given, and the main results hitherto obtained are presented. These concern the technological equipment of the steam generator feeding including the HT recovery, turbines including the separators, seal and bleeder steam, condensers, turbine lubricating and regulating oil, main pumps, generator including its auxiliary water cooling system, inserted cooling circuit, gas management, oil management as well as the low-pressure recovery and the tower cooling circuit. (author.). 3 tabs.

12708 (INIS-mf–12781, pp. 76-80) **Design and checking of in-service diagnostic system for WWER-1000 steam generator and pressurizer.** Matal, O. et al. (Vyzkumny Ustav Energetickych Zarizeni, Brno (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water*

reactors. Part 2. Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A brief description is given of the systems of vibration measurements, residual lifetime assessment, moisture measurement, and chemical diagnostics for WWER-1000 steam generators and pressurizers; the procedures of their testing on unit 1 of the Temelin nuclear power plant are outlined. (author.). 1 tab., 5 refs.

12709 (INIS-mf–12781, pp. 81-85) **Set of computer programs for WWER-1000 nuclear power unit.** Mueller, V. (Skoda, Plzen (Czechoslovakia)); Svarny, J.; Svitak, F.; Krizek, P.; Valenta, V. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Programs for calculations of WWER-1000 units are characterized. The principal codes for neutron physics calculations are WIMS and MOBY-DICK. The program APRO serves the creation of few-group libraries, whereas the code HEXALOK is used for supplementing the detailed power distributions in a fuel assembly. The basic thermonuclear characteristics of the unit are determined by the program STAMOD, thermophysical calculations of the reaction core are performed by using the program CALOPEA. The unit dynamics is simulated by the program SIDY. Other important programs, pertaining particularly to accident and transient states, include the codes RELAP/MOD6, HEPRO, NATURE, KOPR and TETA. Dose equivalent rates and heat sources in structural materials are solved by the program set SOPRGA. The modular program system TRABAK is available for solving activity transport and balances. (Z.M.).

12710 (INIS-mf–12781, pp. 86-92) **Results of R+D of secondary circuits of WWER-1000 nuclear power plants.** Paukner, J. (Skoda, Prague (Czechoslovakia). Vystavba Elektraren). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The results of R+D activities concerning WWER-1000 secondary circuits are summarized. In the field of thermodynamics, the number of recovery degrees and the variable-pressure turbo-set operation were optimized, with a favourable impact on the heat consumption. Data were also acquired for a final proposal for a thermal mode of the turbo-set and for the Temelin nuclear power plant secondary circuit. Reliability analyses were performed for important components and assemblies of the turbo-set and selected subsystems of the secondary circuit. In the technical diagnostics field, a concept of the automated secondary circuit diagnostic system was elaborated, this system being integrated into the diagnostic system of the plant as a whole. Attention was also paid to dynamic effects and transients, earthquake resistance and physicochemical effects of the substances involved, particularly to the erosion corrosion and to corrosion effects on the various types of materials. As a result of the research, all copper alloys were removed and replaced by titanium in the turbine condensers and by steel in the other components. (Z.M.).

12711 (INIS-mf–12781, pp. 93-97) **Deformation calculation for WWER support cylinder during design basis accident.** Pecinka, L. et al. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A code named CYLDY was set up for calculations of the WWER support cylinder stress during a loss-of-coolant accident. The mathematical model includes equations of motion for the propagation of pressure waves in the cylindric space between the walls of the pressure vessel and the support cylinder and for the vibration of the thin-layer cylindric shell. Identity of the radial velocities of the two phases was postulated as a boundary condition. The phenomenon is assumed to last about 0.1 s and the time-variable stress of the shell surface is assumed to be symmetrical with respect to the plane formed by the axes of the disturbed piping and the support cylinder. The program CYLDY was applied to the calculation of deformations and stresses of V-230 and V-213 type WWER reactors. The results, which are tabulated, are in a good agreement with the results of experiments performed on a stand modeling WWER reactors manufactured in Czechoslovakia. (Z.M.). 2 figs., 1 tab., 10 refs.

12712 (INIS-mf–12781, pp. 98-102) **Development of HEPRO computer program variants for thermohydraulic and radiation analyses of WWER reactor sealed areas.** Putik, M. (Skoda, Plzen (Czechoslovakia)); Mueller, V. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The developmental series of the code HEPRO is a set of integral computer programs for the analysis of pressures, temperatures and radiation in the hermetic spaces of WWER units during loss-of-coolant accidents. The calculation method is described and some results are presented characterizing the course of the process during a combination of a LOCA with a hermetic space leak effect. (author.). 1 fig., 3 refs.

12713 (INIS-mf–12781, pp. 137-143) **Problems of constructing few-group libraries for WWER-1000 reactors.** Svarny, J. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The creation of few-group libraries for neutron-physics calculations of the WWER-1000 reactor core is described. In contrast to WWER-440 reactors, WWER-1000 reactors require that allowance be made for the effect of control clusters, burning-up absorbers, the large size of the fuel assemblies and their profiling by enrichment. Specific problems of parametrization of constants for WWER-1000 reactors are associated mainly with the appreciable spectral distortion caused by the high cluster absorption. A parametrization method was therefore suggested addressing this effect via the so-called 1st and 2nd kind indices. An alternative parametrization method, where the accumulation (burning-up) of a limited number of isotopes will be taken as a parameter, is under development. (Z.M.). 1 fig., 12 refs.

12714 (INIS-mf–12781, pp. 162-166) **Preparation of few-group diffusion constants for WWER-1000 reactors.** Vacek, J. (Skoda, Plzen (Czechoslovakia)); Mikolas, P. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Procedures for the preparation of few-group diffusion constants are described making allowance for the heterogeneous structure of WWER-1000 assemblies as compared to WWER-440 assemblies (control with absorbing rod bundles, burning-up absorbers, fuel profiling, etc.). Possibilities of solution are outlined and partial results are presented. (author.). 1 fig., 11 refs.

12715 (INIS-mf–12781, pp. 103-113) **Procedures of strength securing of nuclear power plant equipment and piping.** Roucka, M. (Kralovopolska Strojirna, Brno (Czechoslovakia)); Randula, R.; Rohovsky, K.; Tomeckova, Z. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Programs for strength calculations of nuclear power plant equipment and piping, employed at the Kralovopolska Strojirna engineering works in Brno, are briefly characterized. The programs VYRONA and HORONA are designed for calculations of temperature fields and strains from force and temperature effects in the walls of rotation-symmetric vessels. Seismic effects on vessels are evaluated by means of the programs SAP IV, SEINV and SEINH. The programs JAPAR and UCELENA serve pipe system calculations. Attention is also paid to standards for strength calculations, and ASME regulations are recommended for future work. (Z.M.). 6 refs.

12716 (INIS-mf–12781, pp. 114-117) **Water level measurement and control in steam generators of WWER-1000 nuclear power plants.** Rubek, J. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)); Markvart, J.; Bednarik, K. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A method is suggested for measuring the level and steam power in steam generators of WWER-1000 nuclear power plants. It enables, for steam generator level control, to eliminate components that contribute high uncertainty to the measurement as well as orifice gauges deteriorating the plant performance economy. This contributes to the reliability of the level control circuit and to the control quality, particularly during low unit power modes. The measuring method is based on physical laws controlling the phenomena occurring in the steam generator. These include the dependence of the steam content in the steam-water mixture on the steam power of the generator. This dependence can be employed for attaining a shift of the desired level value during a power change directly in the recorded level signal as well as for determining the amount of steam generated. The quality of the control making use of this level and steam power measurement technique was verified over a wide region on a unit dynamics model. (Z.M.).

12717 (INIS-mf–12781, pp. 118-122) **New filtering equipment for nuclear power engineering.** Slanina, S. (Vyzkumny Ustav Vzduchotechniky, Prague (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The ZFK type series of modular filtering equipment for radioactive aerosol and iodine trapping in nuclear power plant venting systems is described. The design of the filtering equipment designed for air flow rates of 2500 to 37500 m^3/hr is outlined and its principal technical parameters and characteristics are given. (author). 1 fig.

12718 (INIS-mf–12781, pp. 123-136) **Use of acoustic emission method in diagnostics of nuclear power plant components.** Stepanek, S. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Slama, K.; Svetlik, M. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The applicability of the acoustic emission technique to the testing of components of nuclear power plant primary circuits is discussed. Detection and analysis of elastic stress waves propagating through the material can be employed to monitor the initiation and growth of cracks in the material, detect and localize loose parts, and detect coolant leaks. The diagnostic system of elastic wave analysis in WWER-1000 primary circuits is briefly described. The pressure vessel and primary piping are tested integrally, whereas in the steam generator and pressurizer, only selected parts are tested. Sets of 10 analyzers will be used at the first 2 units of the Temelin nuclear power plant, the interfacing of a maximum of 16 measuring channels to each analyzer being possible. (Z.M.). 3 figs., 29 refs.

12719 (INIS-mf–12781, pp. 144-148) **Developmental measurements of the optimum surface blowdown location, of temperature fields and strain in selected nodes of 1000 MW steam generator and pressurizer.** Tomas, Z. et al. (Vyzkumny Ustav Energetickych Zarizeni, Brno (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The reasons for and goals of developmental measurements on a WWER-1000 steam generator and pressurizer are discussed. For blowdown measurements, the steam generator of unit 1 of the Temelin nuclear power plant is equipped with 28 probes, out of which 26 are located under the water level whereas two probes are located before and after the separating equipment for separation efficiency evaluation. The concentrations of Na^+, Fe^{2+}, Fe^{3+} and Cl^- ions and oxygen and the electrolytic conductance will be measured in water samples. At exposed sites of the steam generator and pressurizer, the operation load will be established by temperature and stress measurements. Temperatures will be measured with jacketed thermocouples and mechanical stress, with high-temperature tensometers. Active cracks in the lid-collector joint bolts and the state of the upper part of the collector, of the lid and of the dismantable joint will be monitored with acoustic emission sensors. (Z.M.). 2 figs., 4 refs.

12720 (INIS-mf–12781, pp. 149-161) **Determination of fast neutron fluence at WWER-1000 pressure vessel.** Valenta, V. et al. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The influence function method is an effective tool making it possible, by means of tabulated values to rapidly perform three-dimensional calculations of fast neutron fluences for various reactor core loadings and for various nuclear power plant units. The procedure for determining the spatial dependence of the fast neutron fluences in a WWER-1000 pressure vessel is described. For this, the reactor core is divided into sufficiently fine volume elements within which the neutron source can be regarded as coordinate-independent. The influence functions point to a substantial role of sources lying at the reactor core periphery. In WWER-1000 reactors, only 1 or 2 rows of peripheral assemblies are important. The influence function method makes possible a rapid and easy determination of preconditions for the assessment of the residual lifetime of the pressure vessel based on the actual reactor core loadings. (Z.M.). 7 figs., 8 refs.

12721 (INIS-mf–12781, pp. 167-176) **Basic level of automated control.** Vitovec, P. (Skoda, Prague (Czechoslovakia). Vystavba Elektraren). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors,

Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The results are summarized of a research project aimed at that part of the automated system of technological process control in WWER-1000 nuclear power plants addressing the problem of securing the functioning of the system, this part being a component of the so-called basic control level. The major problems dealt with include the basic conception of the control, instrumentation, special tasks of the turbo-set, reliability of the automated control system and control of the power of the unit. (Z.M.). 51 refs.

12722 (INIS-mf–12781, pp. 177-181) **Stress analysis of WWER-type nuclear reactor pressure vessels.** Visner, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Methods of stress analysis employed for a detailed examination of the WWER pressure vessel stress are discussed. The calculations are based on the modern mathematical method of boundary integral equations, while the experimental verification uses tensometric measurements on the vessels during pressure testing and strain measurements by the photoelasticity method. Different methods were combined to refine the stress values calculated according to the corresponding standard, supplement data in the maximum stress points, establish the actual stress values on reactors during their pressure testing, elaborate the boundary integral equations theory, and elaborate the photoelasticity method for stress intensity coefficient measurements. (Z.M.). 2 figs., 11 refs.

12723 (INIS-mf–12781, pp. 187-192) **R+D of condenser and regeneration exchangers.** Vrbsky, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Research and development problems of condensers and recovery exchangers for WWER-1000 nuclear power plants are discussed. With respect to condensers, attention was paid to the effects of their dimensions, to the heat transfer pipe materials, and to a new type of condenser with titanium pipes. As to the recovery exchangers, problems of the exchanger-turbine system dynamics and of other transients were addressed. (Z.M.). 2 figs.

12724 (INIS-mf–12781, pp. 193-201) **Development of position indicator of WWER nuclear reactor control element.** Wagner, K. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Kocandrle, L. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The philosophy and development of position indicators for WWER type reactors are outlined. The approach to the designing of a new-type coarse position indicator for a state-of-the-art WWER-1000 reactor is demonstrated and the function of this indicator is explained, its layout is shown and its basic technical characteristics are given. The program for its stand and in-service tests is also described. (author). 5 figs., 1 tab.

12725 (INIS-mf–12796) **Operation and maintenance of nuclear power plant: National conference proceedings.** Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990 246p. (In Czech, Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The proceedings contain 34 papers, almost all discussing specific problems or the Dukovany nuclear power plant. The major part is devoted to the matters of maintenance, regular and unplanned repairs, decontamination of the steam generator for inspection and repair purposes, various methods of in-service diagnostics. Some papers discuss reactor start-up, safety assurance, unit control and economic aspects. Environmental impacts of the power plant are also tackled. Some special contributions concern corrosion, chemical analysis of the coolant and the diagnostics of electrical equipment. The possibility is discussed of switching WWER reactors to improved fuel cycles with increased fuel burnup. (M.D.). 37 figs., 23 tabs., 47 refs.

12726 (INIS-mf–12796, pp. 1-8) **Technical and economic results of Dukovany nuclear power plant.** Chrobak, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Important data are tabulated on the four units of the Dukovany nuclear power plant including the commencement of the construction, the attainment of the critical condition, the link-up to the grid and the beginning of operation time sequence in electricity production and consumption, failure rate, percentage availability. A separate table compares specific costs of the Dukovany plant and a coal-fired power plant. The annual power production and supply values correspond to the project design. During the first refuelling after 2 years of operation, the guarantee repair is performed, an extended overhaul is performed during the second refuelling when also the diagnostics of the pressure vessel inner surfaces is carried out. This is repeated every four years. The specific fuel cost has been decreasing since the beginning of operation. (M.D.). 6 tabs.

12727 (INIS-mf–12796, pp. 9-22) **Reliability and safety of Dukovany nuclear power plant installation.** Rerucha, F. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The system of reliability and safety monitoring was commissioned with the start-up of the first unit in 1985. The technological process parameters are permanently monitored, periodic checks are performed of the accident and protection systems, inspections take place in service and during shut-downs, materials testing proceeds, etc. An aspect that is most carefully monitored is the number of reactor shut-downs activated by the first kind accident protection system. The reasons included an incorrect operation of the steam generator supply assembly, failures of feedwater pumps, false actions of the turbo-generator protection system. Other failures were not systematic, they involved, e.g., pump glands, leaks in the secondary coolant circuit, electric equipment failures. (M.D.). 2 tabs., 14 figs.

12728 (INIS-mf–12796, pp. 23-36) **Development and concept of maintenance of Dukovany nuclear power plant.** Krenk, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The maintenance concept is based on Soviet experience. In total, 1,278 maintenance personnel are planned for the following branches: preparation, implementation, planning and economics, coordination. Maintenance is aggravated by the fact that repairability of the individual parts was not considered in project designs and thus, accessibility of the individual valves is a problem to be solved on the spot. The problem is ever more complicated by a great

number of various types of components by various manufacturers, resulting in the necessity of using many techniques, many spares and different tools. It is recommended that a proper design of maintenance should become part of the project design, including model tests requirements. Changes are recommended in the organization of maintenance reflecting practical experience. It is recommended that the manufacturers of nuclear power installations should provide technical service of their products in new power plants. (M.D.). 1 tab.

12729 (INIS-mf–12796, pp. 37-41) **Information on OSART mission task in Dukovany nuclear power plant between 4 and 22 September 1989.** Pavel, L. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The inspection concerned the organization of operation and the administration, the preparation of personnel and upgrading of qualifications, power plant operation, technical services, maintenance, radiation safety, chemical modes, preparation for accident situations. 16 experts from all over the world took part, debating 7 hours a day in eight sessions. The final evaluation was very positive. (M.D.).

12730 (INIS-mf–12796, pp. 42-46) **Computers for WWER-440 unit production and technology control.** Rosol, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The systems for technological process inspection and control are of the Soviet origin and were designed in the 70's. They should thus be reconstructed and upgraded or replaced. In the meantime, a number of minor innovations have been accomplished, such as the replacement of relays, substitution of floppy disk drives by Winchester and RAM disk drives, temperature measurement standby systems and a direct control of the Hindukus system. The most important thing is the production of a communication system interconnecting the unit information systems to the central computer and expansion of the unit information system functions. Schematics of the systems are shown.

12731 (INIS-mf–12796, pp. 47-51) **Expert systems as a modern element of the nuclear power plant operation control system.** Reznik, V. (Jaderna Elektrarna, Dukovany (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

A group of specialists has been working since the beginning of 1989 on implementing an expert system for use by operating personnel of the unit control room. It will be provided with a base of knowledge for monitoring the rated operation of the power unit, and an external subroutine will be set up for monitoring unit shutdown with primary coolant circuit cool-down. The system is installed on an IBM PC/AT but a more powerful computer will actually have to be used. (M.D.).

12732 (INIS-mf–12796, pp. 52-61) **Plans for completion of the Dukovany nuclear power plant.** Beck, R. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Although the Dukovany nuclear power plant was built before 31 July 1989, some nonproduction facilities remain to be completed; these include radiorelay connection to Prague, an information and warning system for population in a 30 km radius, heat supply for the Brno city district heating system, electric heating of emergency core cooling tanks containing boric acid, the reactor and steam generator primary circuit venting system, hot channel drainage of the main circulating pump, improved reliability in steam generator level gauging, double monitoring of waste water, engine room roof cooling, generation of overpressure in the unit control room spaces and improved fire protection, extension of the works health centre, reconstruction of storehouses and workshops, and landscaping. (M.D.).

12733 (INIS-mf–12796, pp. 62-70) **Operating safety of the Dukovany nuclear power plant from the viewpoint of the CSKAE State Nuclear Safety Surveillance.** Kriz, Z. (Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia)); Skopal, P. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The documents "Limits and Conditions of Safe Operation of V-213 Units" and "In-Service Inspection Schedule" were completed. The organizations and personnel involved in designing the first category electric power supply concept are criticised for lack of interest and for underrating the nuclear safety requirements. Positive assessment is accorded to the reliability information system using data processing technology. The State Surveillance also permanently monitors activities in the nuclear power plant protective zone. Safety indices are compared in tables used by NRC in the USA for U.S. power plants and those used for the Dukovany nuclear power plant. The Dukovany power units are superior in the majority of indices. (M.D.). 1 tab.

12734 (INIS-mf–12796, pp. 75-80) **Ecological aspects of operation of the Dukovany nuclear power plant.** Kopec, J. (Jaderna Elektrarna, Dukovany (Czechoslovakia)); Pavel, L. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The power plant site occupies about 180 hectares. Ambient air and water are used in the technological process. The air purity is satisfactory whereas the amounts of chemical substances in water are unfavourable. Waste water is reliably cleaned. Water quality testing and measuring systems with alarm displays are being installed. The activity of the effluents is currently so low that they cannot be monitored in the environment. Solid inactive wastes are buried or recycled, radioactive wastes are disposed of within the power plant area. Radioactive effluents amount to 0.2% of the permissible limit in the atmosphere, 15% of the limit in water, and 60% of the permissible limit for tritium. A system of safety measures capable of coping with the maximum project-design accidents has been commissioned. (M.D.).

12735 (INIS-mf–12796, pp. 81-88) **Selected results of analysis of small and medium primary coolant leaks.** Misak, J. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Problems are discussed of leaks through holes with equivalent diameters of less than 200-300 mm which can be repaired without the use of water reservoirs. During such failures, occlusions form in the hot and cold water branches of the main circulating pipe, preventing free flow of steam from the core. The primary circuit depressurization becomes a long-term problem. Processes arising during the pressure reduction and mechanisms of core overheating are discussed. The temperature and pressure changes are slowed down and the primary circuit depressurization is complicated by the

coolant temperatures in the primary and the secondary circuits approaching each other. Improved secondary circuit cooling has a beneficial temperature and hydraulic effect when coping with an accident. (M.D.). 3 figs.

12736 (INIS-mf–12796, pp. 89-96) **Securing nuclear safety of advanced pressurized water reactors.** Klik, F. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Reliability safety assessment makes it possible to evaluate and compare the individual project variants in the stage of designing. The method is a two-stage one, of which stage one is an analysis of the existing units while stage two is an iterative process of seeking a better solution. The process is described of reliability assessment of safety in the development of the Westinghouse AP-1350 and AP-600 advanced pressurized water reactors with outputs of 1,350 and 600 MW, respectively. Emphasis is placed on passive safety systems. The safety of advanced reactors is roughly one order of magnitude higher than that of conventional pressurized water reactors. (M.D.).

12737 (INIS-mf–12796, pp. 97-106) **Putting the Dukovany nuclear power plant into trial and permanent operation and its use ahead of time.** Sedivy, F. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The time sequence is described of preparing the Dukovany nuclear power plant for commissioning before the preset date; the individual agreements and government debates and decisions are discussed. Internal methodology was developed for the acceptance process. The individual objects and operation sections were commissioned gradually. Many requirements by various state bodies had to be satisfied prior to starting the trial operation. The approval process occurred in several stages. (M.D.).

12738 (INIS-mf–12796, pp. 107-112) **In-service diagnostics at the Dukovany nuclear power plant.** Hulin, J. (Jaderna Elektrarna, Dukovany (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

In-service diagnostics aims at improved safety of the primary coolant circuit and increased economics of operation and maintenance. The stable diagnostic system provides monitoring of the reactor vessel, steam generator, inner structure and pipe vibrations. The assessment of the technical condition of the equipment is based on comparing the frequency spectra of the signals with reference spectra. The system of monitoring loose parts in the primary circuit is based on the measurement, by means of piezoelectric accelerometers, of sound waves propagating through the material. This is also applied to the main circulating pumps. The diagnostics of rotary machines is based on the analysis of vibrations and on roll bearings testing. (M.D.).

12739 (INIS-mf–12796, pp. 113-119) **On-line vibration diagnostic system for Skoda 220 MW turbomachinery of unit 4, WWER-440 MW.** Nespor. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The system will provide continuous prediction and detection of failures of the mechanical performance of the turboset. It has so far only been submitted in a draft. The turboset and the stands will be equipped with vibration sensors, and the data will be transmitted to a computer. The monitoring will consist of vibration diagnostics at the rated speed and at a variable speed. All ranges of values and data that will have to be stored in the diagnostic file data bank are discussed. (M.D.).

12740 (INIS-mf–12796, pp. 120-132) **Technical and economic conditions for increasing the burnup and extending the campaign of WWER-440 reactors.** Pazdera, Fr. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Barta, O.; Kloc, K.; Valvoda, Z. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The results are presented of calculations of the dependence of the specific generation cost on the fuel burnup. For WWER type reactors, burnup of 30 MWd/kg is typical. Absolute savings are listed for cases of burnup increased to 45 and 60 MWd/kg U. Increased burnup is facilitated by increased fuel enrichment and is associated with problems of compensation for the increased reactivity at the beginning of the cycle, optimization of refuelling, extension of the campaign, use of burning-up absorbers, and some negative impacts. Special computer programs are developed and experiments performed for tackling those problems. Testing methods are also developed for monitoring the condition of the fuel element cans. No safety problems have so far arisen, and it is expected that the environmental impact of the nuclear cycle will be slightly positive. (M.D.). 4 figs., 3 tabs., 17 refs.

12741 (INIS-mf–12796, pp. 133-139) **Analysis of the accuracy of primary coolant temperature measurement using the SVRK system.** Holous, V. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Kotrc, S.; Schettina, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The causes are sought of differences in the data from resistance temperature sensors and thermoelectric sensors used in measuring the coolant temperature in primary circuits. A model experiment performed in Unit 4 of the Dukovany nuclear power plant gave evidence that the thermoelectric sensors were inaccurate. The differences were due to a false data correction resulting from the neglect of the effect of temperature conditions of the connection boxes. The errors might be corrected by achieving a quasi-isothermal state of the primary circuit following temperature stabilization of the connection boxes, which would be after about 200 to 3000 hours of reactor operation. (M.D.). 3 figs.

12742 (INIS-mf–12796, pp. 140-148) **Basic experience from the development of technologies and equipment for the decontamination of selected facilities of WWER-440 primary circuits.** Krejci, F. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)); Majersky, D.; Solcanyi, M.; Blazek, J.; Hladky, E.; Palicka, L.; Neupauer, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The research is going on in four basic areas, viz., the collection and analysis of data on the contamination of the primary circuit inner surfaces; monitoring of the effect of the surface quality on the decontamination efficiency and of the effect of repeated decontamination on the material; the development and testing of simple reliable devices for decontamination and the development of suitable decontamination technologies. An electrochemical method was developed for removing the corrosion layer based on anodic

dissolution. Several methods were developed for testing the decontamination process, viz., the corrosion loss determination; surface examination by light and electron microscopy, Auger electron spectrometry and X-ray microanalysis; and mechanical tests. Equipment was developed and tested for the decontamination of valves, of the main circulating pump shells and various surfaces. A device will soon be completed for the decontamination of the pressure vessel branches and the pressurizer branches. Research in chemical decontamination was focused on the so-called soft decontamination of the entire primary coolant circuit and on half-dry methods or electrochemical decontamination with solutions. The equipment and the methods were tested in the actual situation of Czechoslovak nuclear power plants. (M.D.). 10 refs.

12743 (INIS-mf–12796, pp. 149-155) **Evaluation of the efficiency of measures aimed at limiting corrosion effects in cooling water systems.** Peca (Jaderna Elektrarna, Dukovany (Czechoslovakia)); Shejbal. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Structural and technological measures aimed at limiting corrosion effects in cooling systems were studied. The principal causes of increased corrosion are the aggressiveness of the water being cleared and fluctuations of its quality. The water pH varies from acidity to alkalinity and the concentration of chloride ions varies as well. Based on these findings, measures were taken to improve alkalinity of the water being cleared and to bind the aggressive CO_2. Clearing was minimized. Cathodic protection was applied to the tube plates and turbine condenser water chambers. All the steps taken affected positively the corrosion situation. (M.D.). 2 figs.

12744 (INIS-mf–12796, pp. 156-160) **Geodesy work for the operation and maintenance of nuclear power plants.** Kolman, J. (Geodezie, Brno (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Geodesy work performed at the Dukovany nuclear power plant during its construction and start-up is described. Subsidence is measured in roughly 1000 points. One of the most important measurements is assessing the effect of the movement of the turbomachinery base plate on the deformation changes of the machinery. Geodesy specialists are processing maps of the entire nuclear power plant on a scale of 1:500. (M.D.). 10 refs.

12745 (INIS-mf–12796, pp. 161-166) **Application of computer technology to the compiling of 7-day flexible maintenance schedules.** Siegel, F. (Jaderna Elektrarna, Dukovany (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Basic information and design documents, preparation and the schedule of jobs, the determination of priorities are very important for maintenance. Computer technology plays a major part in this. Software is being developed, the expected savings will be reflected in all sectors of the power plant. An extensive maintenance computer network is expected to be installed by the end of 1990. (M.D.).

12746 (INIS-mf–12796, pp. 167-172) **Experience with in-service inspections and repairs of steam generators and pressurizers.** Bednarek, L. (Vedecko Vyzkumny Uhelny Ustav, Ostrava-Radvanice (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

A separate unit responsible for in-service inspections and repairs of nuclear power plants was established in the Vitkovice Steel Works. Decontamination is recommended prior to steam generator repairs. The technology of repairs of degraded sealing surfaces has been mastered. A device is being completed for eddy current testing of thread nests. Some defects have so far not been repairable in Czechoslovakia; for instance, several dozens of heat exchange tubes had to be capped for steam generator leaks. A Siemens manipulator has been purchased for tube inspection. (M.D.).

12747 (INIS-mf–12796, pp. 173-178) **Experience with the operation and maintenance of unit transformers at the CEZ-Dukovany nuclear power plant.** Gross, J. (Jaderna Elektrarna, Dukovany (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Two types of power transformers are installed in the Dukovany nuclear power plant, viz. a Soviet-made TDC transformer and a 1EC41 Z-1 type of Czech make. The former is reliable and stable, with low gas contents in the oil, the closing flap valves of the oil system, however, are failure prone. Very susceptible to failures are the high-voltage bushings. In the next overhaul to be performed, the oil system flaps will be replaced with valves and Soviet bushings will be replaced with bushings from Micafil. The Czech type is not reliable, exhibiting high gas contents in the oil and oil leaks. Its thermal mode does not match the needs of nuclear power engineering. It is concluded that two types of transformers in one power plant cause difficulties; the transformers should at least be interchangeable. (M.D.).

12748 (INIS-mf–12796, pp. 189-199) **Thermovision, preventive testing and inspections of the electrical equipment of units of the Bohunice nuclear power plant.** Jedlicka, R. (Atomova Elektraren Bohunice, Jaslovske Bohunice (Czechoslovakia)); Brodek, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Preventive testing is performed periodically, owing to which the gradual deterioration of contact resistance on power connections is detected. In 220 MW generators and very-high-voltage bushings, the insulation resistance of the phases to earth, the capacity, the loss factor and charge currents are measured. For the unit transformers, the winding ohmic resistance and magnetizing currents are measured as well. A description is given of the AGA-782 thermovision set, used in testing heavy current facilities in the Bohunice and Dukovany nuclear power plants. The method of measurement by means of a reference heat supply, the evaluation procedure and the defects detected are described. (M.D.).

12749 (INIS-mf–12796, pp. 200-212) **Damage of primary collector bolts of steam generators of units I and II of SEP Bohunice nuclear power plant in 1989.** Fried, I. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

115 out of 204 bolts were defected. The manufacturer's records showed that the bolt material was free of faults, and thus the causes of the defects were sought elsewhere. The material was subjected to capillary, ultrasonic, eddy current and metallographic analyses. Metallographic analysis of the lubricant was also performed. Intergranular cracks were detected; these were due to stress corrosion cracking, probably caused by chemical changes in the lubricant (molybdenum sulfide) bringing about changes in the

corrosion medium and deposition of chlorides in the threads. Mechanical stress is another risk factor. It is recommended that a different lubricant be used and tensometric measurements be performed, or alternatively, a more suitable type of steel be developed. (M.D.). 3 tabs., 1 fig., 4 refs.

12750 (INIS-mf–12796, pp. 219-220) **State of the art in automated data collection from chemical analyzers.** Vagner, F. (Jaderna Elektrarna, Dukovany (Czechoslovakia)). Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The output of chemical analyzers is converted to a current signal and brought to an analog-to-digital converter. The processed signal is applied to a PDP 11/23 computer. The following data are evaluated for turbines: cation exchanger conductivity in the condensate pump delivery head, cation exchanger and non-cation-exchanger conductivities in feedwater, and oxygen concentration in the condensate pump delivery head. In the Dukovany nuclear power plant, a complex system is installed for detecting the radionuclide composition of the primary circuit coolant by continuous gamma spectrometry. The concept of data processing allows for further extension of the automated data acquisition. (M.D.).

12751 (INIS-mf–12796, pp. 221-223) **Operating experience with the decontamination of the main technological facilities of nuclear power plants.** Kopecky, P. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Experience from the decontamination of the steam generator in Unit 4 of the Dukovany nuclear power plant is summed up. The secondary circuit was not disassembled. The dose rate on the secondary side had to be reduced to below 1 mGy/h. Decontamination was performed using DEKOZ PG equipment in one decontamination run. Solutions containing NaOH, $KMnO_4$, oxalic acid, citric acid and H_2O_2 were used. After the decontamination, the activity was 20 μGy/h. (M.D.). 4 tabs.

12752 (INIS-mf–12796, pp. 224-227) **Technical and economic problems of switching WWER-440 reactors to improved fuel cycles.** Majercik, J. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)); Petenyi, V. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Without the use of new types of fuel assemblies, the mean enrichment of the fuel charged can be increased to a maximum of 3.45%, i.e., 24 assemblies at an enrichment of 3.6% can be left in the reactor in the fourth year. The mean burn-up will increase to 31.3 MWd/kg U and the specific fuel cost will drop 2.9%. The introduction of a complete four-year fuel cycle will allow fuel to be used at an enrichment of up to 4.4%. The mean burnup will increase to 37.8 MWd/kg U and the specific fuel cost will be 11.5% lower than for the three-year cycle using standard fuel. (M.D.). 1 tab.

12753 (INIS-mf–12796, pp. 228-232) **A new type of automatic device for the determination of the concentration of boron in nuclear power plant primary coolant circuits.** Kysela, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Racek, J.; Cerny, M.; Bartovsky, T.; Petros, L. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The boron meter consists of a sensor in form of a measuring cuvette with a neutron detector in the middle. The liquid being tested flows through the sensor. The cuvette is surrounded by water containing also a neutron source. Resistance thermometers are used for temperature compensation in the cuvette and in the vessel with water. The neutron detector signal is processed using a preamplifier placed next to the vessel. For the sake of maximum resistance of the device, the other electronic parts are built in a so-called transmitter which can be placed at a distance of up to 15 m. The report on the results of measurement is transmitted in digital form along a serial line to a computer. The boron meter was experimentally calibrated and then tested in operation in the Dukovany nuclear power plant. (M.D.). 1 fig.

12754 (INIS-mf–12796, pp. 237-239) **Measurement of the thermal output of the primary circuit.** Holous, V. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Schettina, J.; Jukl, M.; Trejbal, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements were performed using a system based on the programmable Orion Delta facility from Solatron-Schlumberger. The software allows implementing 12 cycles of measurement at one-minute intervals, averaging the samples, evaluating individual specific energies and weight flow rates of the coolant in the individual branches, the outputs of the individual steam generators and the output of the primary circuit as a whole. The measured and the calculated values are cumulated for the calculation of hourly averages. The flow rate determination tolerance is ca. 0.5%, the differences in the measurements range from 0.1 to 0.35%. (M.D.). 1 fig.

12755 (INIS-mf–12796, pp. 240-242) **A rare gas and radioiodine monitor in the CAMAC system and experience with its operation.** Kapisovsky, V. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)); Kubik, I.; Sevecka, S.; Kopec, J.; John, A. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The detection part of the monitor consists of two identical detection units with NaI scintillation detectors. The detection volume is formed by a cylindrical duralumin vessel in which an organic glass cartridge filled with filter material is inserted. The electronic part consists of CAMAC system units. An alphanumeric display and a printer are the means of display. The monitor shows bulk activities of the measured radionuclides in 60 s intervals, the overall values of the respective radionuclide releases at the given time, the attainment of indication levels, the time behaviour of bulk activities over the past 24 hours, and the gamma spectrum histogram, and produces a measurement protocol. It can also operate in the multichannel amplitude analyzer mode. (M.D.). 4 refs.

12756 (NUREG/CR–5312) **A thermodynamic model of fuel disruption in ST-1.** Grimley, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 20p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (SAND–88-3324). Source: OSTI; NTIS; INIS; GPO.

Preliminary examination of the fuel cross-sections from the ST-1 test indicates that the portion of the irradiated fuel that appeared to be severely disrupted in the radiographs may well have undergone some sort of partial melting process. This type of disruption has not been observed in any previous tests involving the BR-3 fuel and it is felt that the highly reducing environment used in ST-1 may be a significant factor in the observed disruption. Significant fuel relocation was also observed in the Oak Ridge VI-4 test which was performed using conditions as much like ST-1 as possible. An inspection of the U-O phase diagram (Figure 1) shows that one

would not expect to observe molten urania at temperatures below 2693K. This temperature is considerably higher than the 2500K maximum fuel temperature achieved in the ST-1 test. The lower temperature portion of the phase diagram (Figure 2) indicates that at temperatures extant in the ST-1 test one could find liquid uranium if the O/M ratio of the fuel were sufficiently reduced. In the ST-1 test, the coolant flow gas was a 1:2 mixture of hydrogen in argon. This mixture presents a reducing environment for the fuel. The existence in the package of a large quantity of unoxidized zirconium adds to the overall reducing nature of the test environment. A thermodynamic model that qualitatively accounts for the observed fuel disruption in the ST-1 test is presented. The model is based on Winslow's equation for the oxygen pressure over hypostoichiometric fuel and the reducing nature of the test atmosphere. The stoichiometry of the fuel is calculated as a function of temperature. This calculation predicts partial liquefaction of the irradiated fuel in the test. 8 refs., 2 figs., 2 tabs.

12757 (PSI–71) **Contributions to technical and economic aspects of high converters.** Chawla, R.; Boehme, R.; Dreier, J. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1990. 62p. Order Number DE91003073. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers were processed separately for the database. (DLC)

12758 (PSI–71, pp. 8-22) **The Proteus phase II experiments as data base for LWHCR physics validation.** Chawla, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Berger, H.D.; Hager, H.; Seiler, R. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1990. In *Contributions to technical and economic aspects of high converters.* 62p. Order Number DE91003073. Source: OSTI; NTIS (US Sales Only); INIS.

Twelve different test zones, Cores 7 to 18, have been studied to date in the Phase II program of LWHCR physics experiments at the PROTEUS zero-power facility. This paper reviews the test lattice configurations investigated, the types of integral measurements carried out, experimental techniques and accuracies, the transferability of results to LWHCR design, as also typical comparisons with calculations based on standard LWR methods. It has been shown that the experimental data base provided is broad - in terms of both high converter design characteristics represented and the types of integral data measured. Thus, the experimental program covers changes in moderation ratio (lattice geometry) and effective fissile-Pu enrichment - with investigations of neutron balance components, moderator voidage effects, influence of lattice poisoning, relative control rod worths and core heterogeneity effects. The importance of having such a broad data base is illustrated by the trends currently reported for the C/E (calculation/experiment) variation for reaction rate ratios with degree of moderation. (author) 6 tabs., 3 figs., 18 refs.

12759 (PSI–71, pp. 54-62) **Lessons learned from the PWHCR development.** Brogli, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Kuczera, B.; Moldaschl, H.; Oldekop, W. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1990. In *Contributions to technical and economic aspects of high converters.* 62p. Order Number DE91003073. Source: OSTI; NTIS (US Sales Only); INIS.

The pressurized water high conversion reactor (PWHCR) concept, derived from the German Convoy PWR, is aimed at greater flexibility in fuel utilization as well as improved safety. The necessary R and D efforts are being carried out in joint co-operation between Siemens KWU, the Karlsruhe Nuclear Research Center, the Paul Scherrer Institute and the Technical University of Braunschweig. The key technical areas for experimental and theoretical investigations have been neutron physics, stationary and reflooding thermal-hydraulics, mechanical design and materials behaviour. A considerable extension of the knowledge base for LWR systems has been achieved. (author) 1 tab., 12 refs.

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Refer also to citation(s) 12657, 12828, 12829, 12830, 12839, 12847, 12852, 12853, 12854, 13052, 13229, 13513

12760 (IAEA-TECDOC–577, pp. 65-68) **Advanced fuel technology - A UK perspective.** Bull, A.J. (British Nuclear Fuels plc, Preston (UK). Springfields Works). International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

The nuclear power industry in the United Kingdom is perhaps more diverse than in any other country. The diversity in design of stations is matched by a diversity in operating responsibility. The SGHWR and PFR are operated by the United Kingdom Atomic Energy Authority (UKAEA), 2 of the Magnox stations are owned and run by BNFL, 2 of the AGR stations and 1 Magnox station are controlled by the South of Scotland Electricity Board (SSEB), and the remaining reactors (including the Sizewell 'B' PWR) currently come under the responsibility of the Central Electricity Generating Board (CEGB) but will pass into the control of a new state-run company when the rest of the CEGB is privatized in 1990. Against this background of a variety of designs and operational responsibilities, there is clearly a great deal of scope for advances in fuel and fuel component technology. It should be noted, however, that the nuclear energy policy within the United Kingdom, particularly with regard to PWR plants, has been to adopt well proven designs wherever possible. Emphasis is therefore directed towards achieving the successful operation of conservative systems, with research and development work on advanced options for future implementation. The following sections give an overview of the areas where advanced designs are either in production or under development for each of the UK reactor systems in turn, together with an indication of possible future developments.

12761 (IAEA-TECDOC–577, pp. 83-95) **Research and development of HTGR fuel at JAERI.** Fukuda, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of Fuels and Materials Research); Yamagishi, S.; Ikawa, K.; Shiba, K. International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

Research and development of HTGR fuels which have been carried out at Japan Atomic Energy Research Institute (JAERI) is described. The HTGR projected at JAERI is called High Temperature engineering Test Reactor (HTTR). The HTTR core consists of prismatic fuel blocks including fuel rods, each of which contains annular shaped fuel compacts. TRISO-coated LEU-fuel particles are embedded in the fuel compacts. In irradiation and out-of-pile experiments, the fuels fabricated according to the HTTR design have been tested on the performance under normal operation conditions and under the conditions simulating abnormal transients and accidents predicted in HTTR design. Research has been conducted on the advanced fuel such as ZrC coating, monolithic fuel rods and thorium fuels. (author). 33 refs, 13 figs, 3 tabs.

12762 (IWGGCR–23, pp. 17-94) **Benchmark design of a hot steam header.** Gaertner, G.U. (Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Dec 1990. In *Design codes for gas cooled reactor components: Summary report of a co-ordinated research programme 1986-1988.* 128p. Order Number DE91622797. Source: OSTI; NTIS (US Sales Only); INIS.

The International Atomic Energy Agency (IAEA) initiated a Coordinated Research Programme (CRP) on "Design Codes for Gas-Cooled Reactor Components". The specialists proposed to

start with a benchmark design of a hot steam header in order to get a better understanding of the methods in the participating countries. The contribution of Federal Republic of Germany was planned as a joint effort of the working group "HTR-Auslegungskriterien". The main effort has been made by Interatom. The following report summarized the detailed calculations of dimensioning procedure and analysis. (author). 3 refs, figs, tabs.

12763 (IWGGCR–23, pp. 95-102) **JAERI's analysis and evaluation results for the steam generator hot header benchmark design problem.** Saito, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Hada, K. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Dec 1990. In *Design codes for gas cooled reactor components: Summary report of a co-ordinated research programme 1986-1988.* 128p. Order Number DE91622797. Source: OSTI; NTIS (US Sales Only); INIS.

The International Atomic Energy Agency (IAEA) initiated a Coordinated Research Programme (CRP) on "Design Codes for Gas-Cooled Reactor Components". The specialists proposed to start with a benchmark design of a hot steam header in order to get a better understanding of the methods in the participating countries. The following report summarizes the detailed calculations and results obtained by the JAERI. (author). 3 refs, 12 figs, 3 tabs.

12764 (IWGGCR–23, pp. 103-105) **Primary design phase of a hot steam header benchmark design.** Hada, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Saito, S. International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Dec 1990. In *Design codes for gas cooled reactor components: Summary report of a co-ordinated research programme 1986-1988.* 128p. Order Number DE91622797. Source: OSTI; NTIS (US Sales Only); INIS.

The International Atomic Energy Agency (IAEA) initiated a Coordinated Research Programme (CRP) on "Design Codes for Gas-Cooled Reactor Components". The geometry and boundary conditions which were defined for this problem are presented. Design results are presented for wall thickness and nozzle reinforcement. (author). 5 figs, 1 tab.

12765 (IWGGCR–23, pp. 106-111) **Hot steam header of a high temperature reactor as a benchmark problem.** Demierre, J. (Sulzer Bros. Ltd., Winterthur (Switzerland)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Dec 1990. In *Design codes for gas cooled reactor components: Summary report of a co-ordinated research programme 1986-1988.* 128p. Order Number DE91622797. Source: OSTI; NTIS (US Sales Only); INIS.

The International Atomic Energy Agency (IAEA) initiated a Coordinated Research Programme (CRP) on "Design Codes for Gas-Cooled Reactor Components". The specialists proposed to start with a benchmark design of a hot steam header in order to get a better understanding of the methods in the participating countries. The contribution of Switzerland carried out by Sulzer. The following report summarized the detailed calculations of dimensioning procedure and analysis. (author). 5 refs, 2 figs, 2 tabs.

12766 (IWGGCR–23, pp. 112-128) **Header nozzle strength calculations for HTGRs.** Popov, S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). International Working Group on Gas-Cooled Reactors. Dec 1990. In *Design codes for gas cooled reactor components: Summary report of a co-ordinated research programme 1986-1988.* 128p. Order Number DE91622797. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents results of strength, calculations of the hot steam header for a high-temperature gas-cooled reactor. The effect was carried out within the frame of the IAEA Coordinated Research Programme on Design Codes for Gas-Cooled Reactor Components. The benchmark problem is defined and the selection of basic dimensions is presented. It is concluded that the header nozzle satisfies both static and long term cyclical strength conditions and that inelastic limiting conditions are not reached as a result of the initial force and temperature loads. (author). 1 ref., figs and tabs.

12767 (JAERI-M–90-103, pp. 5-15) **International aspects of HTGR development.** Kupitz, J. (International Atomic Energy Agency, Vienna (Austria)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

For about 30 years the HTGR has been under development in several countries, such as the Federal Republic of Germany, France, Japan, Switzerland, USSR, UK and USA. The technical feasibility and the advantages of this reactor line have not only been demonstrated by experimental results but also by the successful operation of a number of experimental and demonstration reactors. While HTGRs have not yet been commercially deployed on a large scale, their potential to provide, besides electricity, high temperature process steam and process heat for various industrial applications has been, together with high safety margins, the continuous incentive for further development. During the last decade particular attention has been paid to HTGR module type reactors, which have emerged in the Federal Republic of Germany, USA and USSR. The specific advantages of this concept have contributed to a strong, renewed international interest in the HTGR for electricity generation and process steam production. The successful construction and operation of the HTTR in Japan will provide for important data and experience still necessary for the HTGR to produce high temperature nuclear process heat. (author).

12768 (JAERI-M–90-103, pp. 16-27) **History, salient features and prospectives of HTGR.** Schulten, R.A. (Technische Hochschule Aachen (Germany, F.R.)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

During the last decades ceramic fuel elements with coated particles have been developed to applicability. In combination with helium as a coolant they allow temperatures of up to 1000degC while keeping the contamination of the primary loop to a minimum. This opens new areas of application for nuclear power exceeding the mere generation of electricity. A new technology of nuclear safety has been discovered, which masters the dangers of all unintended changes in reactivity and core heatup due to decay heat. Even corrosion due to air or steam leaking into the primary loop can be avoided sufficiently. A new development of fuel elements with a coating of silicon carbide will avoid all possibilities of corrosion in a simple and transparent way. The objective is a security technology which is based only on the behavior and the properties of the fuel elements. The other components of the power plant should not have any function in the retainment of fission products. Any perceptible impact on the environment due to radioactivity can be ruled out in all cases. The new self driven safety concept simplifies the power plants by rendering certain components obsolete and by lowering the necessary standards for construction. This seems to be important for the acceptance and for the use of this technology in threshold and developing countries. Due to the development of the fuel element and the SiC coating as a protection against air ingress into the primary loop the High Temperature Reactor can also be employed in a combination of a gas and steam turbine loop and thus increase its efficiency considerably. Simplification of nuclear technology, mass production and the increase of efficiency provided by combination plants will improve the economic performance also for units with a rather low power output in the range of 200 to 500 MW_{el}, e.g. by coupling several units. (author).

12769 (JAERI-M–90-103, pp. 31-45) **Current status and future plan of HTGR in Japan.** Ida, Katsuhisa (Science and Technology Agency, Tokyo (Japan)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies

design, licensing requirements and supporting technologies. Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

A high Temperature Gas-Cooled Reactor (HTGR) has excellent characteristics such as producing heat at higher temperature, higher inherent safety and higher fuel burnup, and is considered as one of the most promising nuclear reactors to improve the economy and to extend the application of nuclear energy. Therefore, Japan has been involved since 1969 in R and D for a Multipurpose Very High Temperature Gas-Cooled Reactor (VHTR) in collaboration with associated organizations and institutions. In 1987, the Japanese Atomic Energy Commission (JAEC) issued the revision of Long-Term Program for Development and Utilization of Nuclear Energy, recommending that Japan should proceed with the development of more advanced new technologies for the future, in parallel with the existing nuclear system. Then, the Japan Atomic Energy Research Institute (JAERI) decided to construct the High Temperature Engineering Test Reactor (HTTR) instead of the experimental VHTR in order to establish and upgrade the technology basis for an HTGR, serving at the same time as a potential tool for new and innovative basic research. In order to establish and upgrade HTGR technology basis systematically and efficiently, and also to carry out innovative basic researches on high temperature technologies, Japan will carry out necessary R and D in cooperation with the JAERI, universities, national research institutes as well as industries. In addition, in order to promote the R and D on HTGR more efficiently, Japan will promote the existing international cooperation with the research organizations in foreign countries. (author).

12770 (JAERI-M–90-103, pp. 51-72) **Utility/User requirements for and assessment of MHTGR.** Kessler, W.E. (Consumers Power Co., Jackson, MI (USA)); Mears, L.D.; Gotschall, H.L. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes utility participation through Gas-Cooled Reactor Associates (GCRA) in the Modular High Temperature Gas-Cooled Reactor (MHTGR) program and the rationale for the selection of key requirements in the context of a business risk management philosophy. It also provides a summary assessment of the current design against key top level requirements. (author).

12771 (JAERI-M–90-103, pp. 73-87) **Experience gained with High Temperature Reactor and their prospects.** Balthesen, E. (Forschungszentrum Juelich GmbH (Germany, F.R.)); Diehl, H. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The Federal Republic of Germany can look back on a major programme on the development of high temperature reactors. Experience has been gained over the last three decades with the construction of the pilot plant pebble bed reactor AVR and the demonstration reactor THTR 300 as well as with an extensive R + D programme. At the end of the fifties the programme was launched shortly after nuclear activities for the peaceful uses of atomic energy were permitted in the Federal Republic of Germany. In concurrence with similar programmes in other countries the main motivation was to provide a highly economic power supply. In the sixties the AVR was built, successfully taken into operation and the THTR was designed as the next step. The German programme in cooperation with Switzerland, concentrated on advanced power plant concepts utilizing gas turbine technology in parallel to the start of THTR construction. (author).

12772 (JAERI-M–90-103, pp. 88-103) **Present status and development strategy of the HTGR program in PRC.** Wang Dazhong (Quinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Zhong Daxin. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

This paper summarizes the present status and main progress of chinese HTGR R and D program. It is being carried out in the INET and the relevant institutions and covered in the national high technology research and development program. Briefly introduces the technical features of the 10 MW HTR-Test Module which will be a joint project with Siemens-Interatom, KFA Juelich. Some preliminary results and prospects of HTGR application in the heavy oil recovery and petrochemical complex are also described. At last, this paper discusses the role and position of HTGR in the future energy system and its development strategy in China. (author).

12773 (JAERI-M–90-103, pp. 104-116) **Present status and future program of HTR-research and development in Switzerland.** Sarlos, G. (Schweizerische Interessengemeinschaft zur Wahrnehmung gemeinsamer Interessen an der Entwicklung Nukleare Technologien (IGNT), Wuerenlingen (Switzerland)); Bucher, K.H. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

Research, Development and Design of Gas-cooled Reactors have already a long and well accepted tradition in Switzerland. These activities began with the design and construction of an experimental gas-cooled power station of 30 MW by the Swiss industry in the early sixties. Swiss industry restricted themselves to the development and the supply of reactor systems and components only. Through extensive research and the participation in various international projects such as AGR, AVR, FSV, THTR, HHT, HTR etc., it was possible to gain valuable know-how, which qualified the Swiss industry as reliable manufactures of reactor components and enabled them to render all kinds of engineering services for nuclear power plants. In order to utilize the existing vast experience, the companies concerned and the PSI agreed in 1979 to join as partners and established the 'Swiss Community for the Development of Nuclear Technology' called IGNT. Partners of IGNT are ABB, Baden; Sulzer, Winterthur; B + G, Lausanne; EWI, Zuerich; Colenco, Baden; and the Swiss Federal Institute for Reactor Research (PSI). IGNT represents and coordinates the activities of the partners, especially in the field of the high temperature gas-cooled reactors. As a consequence of this partnership, the members of IGNT engaged themselves in the development of the HTR-Technology in general and particularly in the design of the HTR-500. Another project which was pursued in Switzerland over the recent years, is the gascooled heating reactor, a small pebble-bed HTR of 10 to 20 MW for district heating purposes. In 1988 work on this project has been terminated for political reasons, but will probably be taken up in 1990/91. (author).

12774 (JAERI-M–90-103, pp. 117-143) **Technology, cost economics and other factors of HTR as relevant to a developing country.** Karim, C.S. (Bangladesh Atomic Energy Commission, Dhaka (Bangladesh)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

HTR could be a technology useful to many developing countries provided its economic performance is proved to be better than its alternatives. Logically the specific cost should be lower than other SMPRs and there is no reason why such a plant could not be built at a specific cost stated earlier. The technology, especially with respect to safety and licensing has certain points that need further clarification. Issuance of a non-site specific license/design clearance in the manufacturer's country could add to the confidence in the buyer country. The codes, standards and guides applicable to HTRs are not as exhaustive as for LWRs, especially the PWRs. It is true, a few HTRs have been licensed and are operating in the developed countries and some codes, guides and standards could be in existence in those countries. These need to be compiled and new ones developed to ensure their completeness. This could be achieved only through international cooperation. International/ collaborative studies may also be carried out on certain technical aspects like the applicability and adequacy of the passive safety systems in the event of a design basis accident, independent confirmation that in the worst case of such a situation the maximum fuel temperature will remain far bellow its melting point, temporary storage and final disposal of waste and spent fuel, possibly in collaboration with a third country willing to cooperate in this respect, effect on the core in case of water ingress from the steam generator, analysis of different cases of accidents, exchange of design information, standardization of fuel elements, etc. In parallel, the suppliers should realistically firm up their cost estimation and also the fuel cycle cost. International cooperation in solving the problem of financing is yet another area, which needs urgent attention. (author).

12775 (JAERI-M–90-103, pp. 144-153) **Progress on HTR application's study in Indonesia.** Subki, I. (National Atomic Energy Agency, Jakarta (Indonesia)); Djokolelono, M. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

Study on the application of HTRs for the enhanced oil recovery in the Duri oil field (Sumatra, Indonesia) was performed in 1986/ 1987. The economic and technological advantages over crude burning option were identified. Crude oil prices, HTR capital costs, discount rates, company's income structure represented dominant parameters. Further sensitivity calculations on important economic parameters were obtained to reflect the condition of 1988. This nuclear option was also incorporated in the energy planning study for the whole Indonesia using the MARKAL model, and resulted the conditions of its applicability. The scenarios chosen in this MARKAL study were high and low GDP growth rate, whereas the criteria chosen were the minimum cost with and without a predetermined policy of reduced domestic use of oil. In the high scenario the HTRs as well as the natural gas options could not compete against the low cost boilers with crude-oil fuel. But in the case of reduced domestic oil use the HTRs came out to supplement the crude-burning boilers starting in the sixth five year plan (1994 - 1999), even earlier than the natural gas option. The authors further discuss the industrial environment, in relation with the regional development, the possible local participation, as well as the plan to materialize the merits of this novel application. (author).

12776 (JAERI-M–90-103, pp. 184-197) **Modular High Temperature Gas-Cooled Reactor design.** Bramblett, G.C. (General Atomics, San Diego, CA (USA)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The Modular High-Temperature Gas-Cooled Reactor (MHTGR) is an advanced power plant concept which has been under development since 1984. The design utilizes basic high temperature gas-cooled reactor features of refractory coated fuel, helium coolant and a graphite moderator which are supported by design studies and experience of over 30 years. The design is being developed based on selections made in response to well defined requirements for safe, reliable and economic power. The geometric arrangement of the reactor and steam generator vessels, the core and the heat removal components has been selected to exploit the inherent characteristics associated with high-temperature materials. The design utilizes passively safe features which provide a higher margin of safety and investment protection than current generation reactors. Design features include an arrangement of four identical 350 MW(t) modular reactor units located in underground silos covered by a single reactor building. This Nuclear Island (NI) with the reactors and associated equipment is coupled to an Energy Conversion Area (ECA) with two turbine generators producing a combined total of approximately 540 MW(e). Nuclear heat is normally removed by a steam generation system featuring a once-through design. A shutdown cooling system utilizing water and a reactor cavity cooling system utilizing air driven by natural convection provide alternate heat removal paths. The design and development program, now in the preliminary design stage, is a cooperative effort by the U.S. government, the utilities and the nuclear industry. (author).

12777 (JAERI-M–90-103, pp. 198-238) **Design details of HTR-Module and HTR-500.** Arndt, E.K.W. (Gesellschaft fuer Hochtemperaturreaktoren, Frankfurt am Main (Germany, F.R.)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The modular HTR power plant is a universally applicable energy source for the co-generation of electricity, process steam or district heat. The modular HTR concept is characterized by the fact that standardized reactor units with power ratings of 200 MJ/s (so-called modules) can be combined to form power plants with a higher power rating. Consequently, the special safety features of small high-temperature reactors are also available at higher power ratings. The safety features and the technical design are briefly described. The principal safety feature of the HTR-Module is based on the fact that, even in the case of failure of all active cooling systems and complete loss of coolant, the fuel element temperatures remain within limits at which there is practically no release of radioactive fission products from the fuel elements. The HTR-500 has been developed as a nuclear power plant for medium-sized and large power grids, either as a base load plant or for load-following applications according to the requirements of the grid. Furthermore, the HTR-500 is well suited for the cogeneration or supply of process steam for industrial applications. The HTR-500 has a thermal power output of 1390 MJ/s, which corresponds to an electrical rating of 550 MW. The reactor plant concept is marked by the integrated arrangement of all primary-system components within a burst-proof pre-stressed concrete reactor vessel in single-cavity design. The integrated arrangement provides protection against impacts from internal incidents as well as radiation shielding. (author).

12778 (JAERI-M–90-103, pp. 319-336) **Research and development associated with licensing of MHTGR.** Jones, H. (Oak Ridge National Lab., TN (USA)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only): INIS.

The Modular High Temperature Gas-Cooled Reactor (MHTGR) currently under development by the US-DOE for commercial applications has top-level goals of producing safe, economical power for the U.S. utility industry. The utility industry has been represented in formulating design and licensing requirements through

both a 'Utility User Requirements Document' and by participating in the DOE system engineering process known as the 'Integrated Approach'. The result of this collaboration has been to set stringent goals for both the safety and operational reliability of the MHTGR. To achieve these goals, the designer must have access to a more comprehensive data base of properties in several fields of technology than is currently available. A technology development program has been planned to provide this data to the designer in time to support both his design activities and the submittal of formal licensing application documents. The US-DOE has chosen the ORNL to take the lead in planning and executing these technology programs. When completed these will augment the designer's current data base and provide the necessary depth to meet the stringent goals which have been set for the MHTGR. It is worth noting that the goals of safety and operational reliability are complementary, and the data required from the technology development program will be similar. Therefore, the program to support the licensing of the MHTGR is not separate from that required for design, but is a subset of that which meets all the requirements that result from implementing the US-DOE's integrated approach. This paper will provide an overview of the technology development activities now in progress or planned by ORNL to meet these requirements. Work will be described in the fields of fuel development, fission product release and transport, graphite technology, metallurgical technology, reactor shielding, safety research, and the validation of design methods in thermal/hydraulics. (author).

12779 (JAERI-M–90-103, pp. 337-356) **Research and development requirements before and beyond licensing the HTR-Module.** Kirch, N. (Forschungszentrum Juelich G.m.b.H. (Germany, F.R.)); Wolters, J. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

Due to a broad R + D program since more than 25 years including the successfull operation of AVR and THTR in Germany, the HTR system can be regarded as a mature technology. Since about ten years, the German HTR-Module concept is under investigation. Several risk and safety assessments have given evidence of the unique safety features of this system. Nearly all proofs for the licensing procedure could be given today; R + D tasks to facilitate the procedure have been identified and are under way. It is very clear, that licensing and construction of a HTR-Module will not fail due to missing R + D results. Most of the ongoing German R + D program is dedicated to questions beyond the direct licensing procedure: Direct final disposal, control of hypothetical accidents, and improvements in economy are the main goals. (author).

2104 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated

Refer also to citation(s) 12458, 12822

2105 Power Reactors, Breeding

Refer also to citation(s) 12497, 12658, 12760, 12800, 12822, 12843, 12844, 12855, 12856, 12867, 13898

12780 (ANL/CP–71359) **Actinide consumption: Nuclear resource conservation without breeding.** Hannum, W.H.; Battles, J.E.; Johnson, T.R.; McPheeters, C.C. Argonne National Lab., IL (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9104106–1: 53. annual meeting and exhibit of the American Power Conference, Chicago, IL (USA), 20 Apr - 1 may 1991). Order Number DE91008815. Source: OSTI; NTIS; INIS; GPO Dep.

A new approach to the nuclear power issue based on a metallic fast reactor fuel and pyrometallurgical processing of spent fuel is showing great potential and is approaching a critical demonstration phase. If successful, this approach will complement and validate the LWR reactor systems and the attendant infrastructure (including repository development) and will alleviate the dominant concerns over the acceptability of nuclear power. The Integral Fast Reactor (IFR) concept is a metal-fueled, sodium-cooled pool-type fast reactor supported by a pyrometallurgical reprocessing system. The concept of a sodium cooled fast reactor is broadly demonstrated by the EBR-II and FFTF in the US; DFR and PFR in the UK; Phenix and SuperPhenix in France; BOR-60, BN-350, BN-600 in the USSR; and JOYO in Japan. The metallic fuel is an evolution from early EBR-II fuels. This fuel, a ternary U-Pu-Zr alloy, has been demonstrated to be highly reliable and fault tolerant even at very high burnup (160-180,000 MWd/MT). The fuel, coupled with the pool type reactor configuration, has been shown to have outstanding safety characteristics: even with all active safety systems disabled, such a reactor can survive a loss of coolant flow, a loss of heat sink, or other major accidents. Design studies based on a small modular approach show not only its impressive safety characteristics, but are projected to be economically competitive. The program to explore the feasibility of actinide recovery from spent LWR fuel is in its initial phase, but it is expected that technical feasibility could be demonstrated by about 1995; DOE has not yet committed funds to achieve this objective. 27 refs.

12781 (ANL/CP–71451) **Interim waste storage for the Integral Fast Reactor.** Benedict, R.W. (Argonne National Lab., Idaho Falls, ID (USA)); Phipps, R.D.; Condiff, D.W. Argonne National Lab., Idaho Falls, ID (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910435–53: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91008813. Source: OSTI; NTIS; INIS; GPO Dep.

The Integral Fast Reactor (IFR), which Argonne National Laboratory is developing, is an innovative liquid metal breeder reactor that uses metallic fuel and has a close coupled fuel recovery process. A pyrochemical process is used to separate the fission products from the actinide elements. These actinides are used to make new fuel for the reactor. As part of the overall IFR development program, Argonne has refurbished an existing Fuel Cycle Facility at ANL-West and is installing new equipment to demonstrate the remote reprocessing and fabrication of fuel for the Experimental Breeder Reactor II (EBR-II). During this demonstration the wastes that are produced will be treated and packaged to produce waste forms that would be typical of future commercial operations. These future waste forms would, assuming Argonne development goals are fulfilled, be essentially free of long half-life transuranic isotopes. Promising early results indicate that actinide extraction processes can be developed to strip these isotopes from waste stream and return them to the IFR type reactors for fissioning. 1 fig.

12782 (CEA-DAS–728) **Comparison of aerosol behavior codes with experimental results from a sodium fire in a containment.** Lhiaubet, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. d'Analyse de Surete); Bunz, H.; Kissane, M.P.; Seino, H.; Miyake, O.; Himeno, Y.; Casselman, C.; Such, J.M.; Rzekiecki, R. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 11p. (CONF-900804–: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE91752700. Source: OSTI; NTIS (US Sales Only).

The containment expert group (CONT), a subgroup of the CEC fast reactor Safety Working Group (SWG), has carried out several studies on the behavior of sodium aerosols which might form in a severe fast reactor accident during which primary sodium leaks into the secondary containment. These studies comprise an intercalibration of measurement devices used to determine the aerosol particle size spectrum, and the analysis and comparison of codes applied to the determination of aerosol behavior in a reactor containment. The paper outlines the results of measurements of typical data made for aerosols produced in a sodium fire and their comparison with results from different codes (PARDISEKO, AEROSIM, CONTAIN, AEROSOLS/B2). The sodium fire experiment took place at CEN-Cadarache (France) in a 400 m^3 vessel. The fire lasted 90 minutes and the aerosol measurements were made over 10 hours at different locations inside the vessel. The results showed that the

suspended mass calculated along the time with different codes was in good agreement with the experiment. However, the calculated aerosol deposition on the walls was diverging and always significantly lower than the measured values.

12783 (CEA-DAS–730) **Phenix operating experience.** Couturier, J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 19p. (CONF-9010334–: Rencontre STA-SCSIN, science and technology agency, Tokyo (Japan), 8-12 Oct 1990). Order Number DE91757106. Source: OSTI; NTIS (US Sales Only).

The fast breeder reactor equipping the PHENIX plant has been in operation for 17 years. Apart from electricity production, operation of the 250 MWe reactor had the following positive results: - it proved that such a reactor could be operated without major difficulties and with a high energy availability factor, - it provided opportunities for fast breeder fuel optimization, - it yielded a certain number of safety lessons of interest in the context of breeder development work. The incidents which have occurred in recent years will be discussed in detail, with attention to the lessons drawn. After reviewing these different events, we shall present various surveys and structural provisions implemented with a view to confirming reactor safety and enhancing certain aspects of it, particularly in the light of the general lessons learned from the Three Mile Island and Chernobyl accidents. Examples will be discussed, such as the tests and inspections carried out during the second ten-yearly shutdown in 1989 (general overhaul), and the definition of procedures to be adopted in case of accidents at the limits or beyond the design basis situations.

12784 (CONF-910413–1) **Recycle of LWR [Light Water Reactor] actinides to an IFR [Integral Fast Reactor].** Pierce, R.D.; Ackerman, J.P.; Johnson, G.K.; Mulcahey, T.P.; Poa, D.S. Argonne National Lab., IL (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 3. international conference on nuclear fuel reprocessing and waste management; Sendai (Japan); 15-18 Apr 1991. Order Number DE91007759. Source: OSTI; NTIS; INIS; GPO Dep.

A large quantity of actinide elements is present in irradiated Light Water Reactor (LWR) fuel that is stored throughout the world. Because of the high fission-to-capture ratio for the transuranium (TRU) elements with the high-energy neutrons in the metal-fueled Integral Fast Reactor (IFR), that reactor can consume these elements effectively. The stored fuel represents a valuable resource for an expanding application of fast power reactors. In addition, removal of the TRU elements from the spent LWR fuel has the potential for increasing the capacity of a high-level waste facility by reducing the heat loads and increasing the margin of safety in meeting licensing requirements. Argonne National Laboratory (ANL) is developing a pyrochemical process, which is compatible with the IFR fuel cycle, for the recovery of TRU elements from LWR fuel. The proposed product is a metallic actinide ingot, which can be introduced into the electrorefining step of the IFR process. The major objective of the LWR fuel recovery process is high TRU element recovery, with decontamination a secondary issue, because fission product removal is accomplished in the IFR process. The extensive pyrochemical processing studies of the 1960s and 1970s provide a basis for the design of possible processes. Two processes were selected for laboratory-scale investigation. One is based on the Salt Transport Process studied at ANL for mixed-oxide fast reactor fuel, and the other is based on the blanket processing studies done for ANL's second Experimental Breeder Reactor (EBR-2). This paper discusses the two processes and is a status report on the experimental studies. 5 refs., 2 figs., 2 tabs.

12785 (CONF-910413–3) **Development of fast breeder reactor fuel reprocessing technology at the Power Reactor and Nuclear Fuel Development Corporation.** Kawata, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works); Takeda, H.; Togashi, A.; Hayashi, S.; Stradley, J.G. Oak Ridge National Lab., TN (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 3. international conference on nuclear fuel reprocessing and waste management; Sendai (Japan); 15-18 Apr 1991. Order Number DE91008378. Source: OSTI; NTIS; INIS; GPO Dep.

For the past two decades, a broad range of research & development (R&D) programs to establish fast breeder reactor (FBR) system and its associated fuel cycle technology have been pursued by the Power Reactor and Nuclear Fuel Development Corporation (PNC). Developmental activities for FBR fuel reprocessing technology have been primarily conducted at PNC Tokai Works where many important R&D facilities for nuclear fuel cycle are located. These include cold and uranium tests for process equipment development in the Engineering Demonstration Facilities (EDF)-I and II, and laboratory-scale hot tests in the Chemical Processing Facility (CPF) where fuel dissolution and solvent extraction characteristics are being investigated with irradiated FBR fuel pins whose burn-up ranges up to 100,000 MWd/t. An extensive effort has also been made at EDF-III to develop advanced remote technology which enables to increase plant availability and to decrease radiation exposures to the workers in future reprocessing plants. The PNC and the United States Department of Energy (USDOE) entered into the joint collaboration in which the US shares the R&Ds to support FBR fuel reprocessing program at the PNC. Several important R&Ds on advanced process equipment such as a rotary dissolver and a centrifugal contactor system are in progress in a joint effort with the Oak Ridge National Laboratory (ORNL) Consolidated Fuel Reprocessing Program (CFRP). In order to facilitate hot testing on advanced processes and equipment, the design of a new engineering-scale hot test facility is now in progress aiming at the start of hot operation in late 90's. 31 refs., 2 tabs.

12786 (EUR–12991) **Influence of design features on decommissioning of a large fast breeder reactor.** Fournie, J.L. (Novatome 69 Lyon (FR)); Alary, C.; Jean, M.; Maire, D.; Peyrard, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 75p. (In French). Contract no FI1D-0056. Source: OSTI; NTIS (US Sales Only).

In the conception and realization studies of a LMFBR, the decommissioning aspects are not much taken in account. It appears that low cost and unsophisticated dispositions can notably facilitate these operations of decommissioning. The objective of this research consists in the identification of the conception and construction measures that can facilitate these operations. By priority we considerate the measures requiring low cost and low development study.

12787 (EUR–13021) **The LMFBR safety case.** Smith, D. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 25p. Source: OSTI; NTIS (US Sales Only).

The main objective of this report is to review the present status of the safety case for the liquid metal cooled fast reactor (FBR). A particular emphasis is placed on activities in Europe where the FBR has been progressively developed for many years during which time systems have passed from small experimental plants to the 1200 MWe SPX-1. The FBR has been found to be an easily controlled plant with low impact on the environment and low dose rates to operational personnel. Aspects of reactor design and associated R and D that are required for FBRs to be licensed and the progress made to meet these requirements are described. Fault conditions in the credible range can be dealt with safely, the FBR having several advantageous characteristics which assist safety. Also measures are foreseen to mitigate potential consequences of more severe but improbable accidents. This study sponsored by the Commission of the European Communities was carried out by Colenco Ltd in vlose collaboration with the Safety Working Group (SWG) which is a subgroup of the CEC Fast Reactor Coordinating Committee (FRCC).

12788 (IAEA-TECDOC–577, pp. 47-64) **Improvements in MOX fuel utilization in Japan and technological developments for an economical FBR fuel cycle.** Mishima, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

Japanese research and development (R and D) activities to realize Pu recycling within conventional oxide form are being carried out by the Power Reactor and Nuclear Fuel Development Corporation (PNC) with the aid of the Japan Atomic Energy Research Institute and utilities. The goals of this R and D are focussed on achieving high burnups and high heat rates, i.e., 80GWd/t average burnup and 360W/cm maximum linear heat rate in the "MONJU" reactor which will go critical in 1992, and 150 to 200GWd/t and 480W/cm in commercial FBRs which will appear in the early 2000s. In the meantime, efforts are also being spent to realize recycling of Pu in water reactors. In this paper, improvements in fuel fabrication, fuel performance and cladding material, and advances in fuel concepts are presented. (author). 6 refs, 11 figs, 1 tab.

12789 (IAEA-TECDOC–577, pp. 73-82) **Research and development of uranium-plutonium mixed carbide and nitride fuels at JAERI.** Suzuki, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of Fuels and Materials Research); Arai, Y.; Handa, M.; Shiba, K. International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

The present status of the development of uranium-plutonium mixed carbide and nitride fuels at Japan Atomic Energy Research Institute (JAERI) is described. The development program covers fuel fabrication studies, fuel property measurements and irradiation tests. The fuels were prepared using the carbothermic reduction of oxides followed by sintering. Procedures for the characterization of the fuels fabricated have been established. The studies of fuel properties cover thermal conductivity, evaporation behavior, chemical potential and so on. Irradiation tests of carbide fuel pins have been carried out by the use of research thermal reactors, JRR-2 and JMTR at JAERI. The carbide and nitride fuels will be irradiated for performance tests in the experimental fast reactor (JOYO) in collaboration with Power Reactor and Nuclear Fuel Development Corporation (PNC). (author). 24 refs, 5 figs, 2 tabs.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 13416

12790 (JAERI-M–90-182) **Design study of marine reactor core.** Ambo, Noriaki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Tahara, Yoshikazu; Okayama, Akira; Shimamura, Kazuhiko. Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1990. 82p. (In Japanese). Order Number DE91755673. Source: OSTI; NTIS (US Sales Only); INIS.

JAERI have carried out four core designs for three different type Reactor of Trial design in FY 1983 $\approx$ 1986 and one core (the optimum core) and three survey cores for conceptual design Reactor in 1987. Based on these cores study results, we are now studying to design MRX CORE. On the other side, we started design study of super-miniaturized 2 MWt core concept for deep-sea submersible. This report describes the results of comparison and studies of the core specification, specific characteristics etc of these cores, and we study that more thick fuel outer diameter (9.5 mm) core was possible or not as for the MRX CORE that has now thin fuel outer diameter (7.0 mm) in consideration of rapid power change etc especially with marine reactor. As the results, it was found that 9.5 mm diameter fuel core was possible and some methods were found, therefore it will be necessary to study the 9.5 mm diameter fuel core in detail continuously. (author).

2107 Regulation and Licensing

Refer also to citation(s) 12778, 12779, 12830, 12852, 12853, 12863, 12892

12791 (NUREG–0540-Vol.12-No.12) **Title list of documents made publicly available, December 1–31, 1990: Volume 12, No. 12.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Feb 1991. 323p. Sponsored by Nuc. Source: OSTI; NTIS; INIS: GPO.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979.

12792 (NUREG–0750-Vol.32-No.6) **Nuclear Regulatory Commission issuances, December 1990: Volume 32, No. 6.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Dec 1990. 107p. Sponsored by Nuc. Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 Economics

Refer also to citation(s) 12655, 12757, 12775, 12860, 12863, 12865, 12899

12793 (INIS-mf–12781, pp. 1-6) **Nuclear power plants in Czechoslovak power engineering.** Cibula, M. (Statni Planovaci Komise, Prague (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The prognosis of the development of Czechoslovak power industry is based on the expected reduction in the energy demand for industrial production and a fundamental restructuralization of energy sources associated with decreasing coal mining, reduction in petroleum products consumption for energy generation, and development of nuclear power industry. In 1995, the primary energy consumption should be 2% higher than in 1990; in 2000 it should be at the level of 1990, and in 2005 it should be 3% lower than in 1995. In the non-industrial sphere, the energy consumption is expected to increase appreciably, while national income, which should be two-thirds higher in 2005 than in 1990, must be created at an energy consumption in the industrial sphere lower by about 40%. Installed capacity of nuclear power plants should increase to 13 280 MW till 2005, when their share in the total power generation should be 56%. (Z.M.). 3 tabs.

12794 (INIS-mf–12781, pp. 23-30) **Regulating and backup capacities.** Erban, P. (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

Demands for power backup for the Czechoslovak electrification system are discussed. In a near future, nuclear power plants will have a decisive share in this system, and so they also will have to participate in the electrification system control; in particular, they will have to take part in the control of the frequency and transmitted power. The problem of weekly nonuniformness of electric work and electric power consumption will become urgent after the year

2000. If attempts to find sufficient weekend electricity consumers (to rely on over the whole year) fail, then on weekends or non-workdays, nuclear power plants will have to work at the lower limit of their control regime. Should nuclear power plants take over the regulating function of pump-storage hydro-electric power plants, they would have to work at a relatively low load and keep a rotation reserve of several GW, which is impracticable in Czechoslovakia because this country is unable to build up such an installed capacity in nuclear power plants. (Z.M.). 4 refs.

22 NUCLEAR REACTOR TECHNOLOGY

12795 (INIS-mf–12171) **KFA Juelich annual report 1986/87.** Kernforschungsanlage Juelich GmbH (Germany, F.R.). 1987 192p. (In German). Order Number DE91756207. Source: OSTI; NTIS (US Sales Only); INIS.

Basic and applied research almost keep the balance in the program of Kernforschungsanlage Juelich GmbH (KFA), one of the FRG's national research facilities. Multidisciplinary work of KFA in various fields of the natural sciences include nuclear medicine, nuclear chemistry, biotechnology, plasma physics/nuclear fusion, nuclear physics, energy and environmental resarch, multiparticle systems research, including related solid-state, surface, and vacuum physics research, and also problems of analyzing large-scale nonlinear systems. Future work will focus on the three major programs 'Materials development', 'Environmental chemicals and ecosystems', and 'Basic research on information technologies'. The chapter 'Examples of research work' contains topical contributions. The 'Report on R and D work' is a survey of all scientific-technical activities. The chapter 'Research institutes and joint scientific and technical facilities' describes tasks and targets of the entire KFA complex. (HK).

2201 Theory and Calculation

Refer also to citation(s) 12866, 13227, 13850, 13897, 13898

12796 (CEA-N–2647) **Calculation of the critical buckling of a lattice based on the integral form of the transport equation.** Benoist, P. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques. Jun 1990. 24p. (In French). Order Number DE91752732. Source: OSTI; NTIS (US Sales Only).

The migration area, which relates the buckling to the multiplication factor, can be calculated by means of the Deniz formula. This formula involves the direct and adjoint angular fluxes. It is shown in this note that it is possible, using the integral form of the transport equation, to establish an equivalent formula in which only angle-integrated quantities appear. This formulation is more suitable for the calculation by the collision probably method.

12797 (CONF-910414–23) **Fission chain length effects on californium-source-driven subcriticality measurements.** Mihalczo, J.T.; Pare, V.K.; Blakeman, E.D. Oak Ridge National Lab., TN (USA). [1991]. 13p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From International topical meeting on advances in mathematics, computations and reactor physics; Pittsburgh, PA (USA): 28 Apr - 2 may 1991. Order Number DE91008369. Source: OSTI; NTIS; GPO Dep.

The treatment of the detection process in the point reactor model significantly affects the predicted cross power spectral density between a pair of detectors because a count in one detector can be associated with a change in the population of a fission chain. This change can affect the probability of a correlated count in the other detector. This paper summarizes the results of the point reactor model for a variety of detection processes involving different population changes. The point reactor model assumes that the detectors have equal access to fission chains of all sizes, but in a typical experiment the detector locations are such that only extremely long fission chain populations are sampled. The effects of the detection process on the subsequent fission chain population are minimized, and the detection process may not satisfy the point reactor assumptions. Formulas modified to incorporate this minimization of detection effects have been used successfully to interpret ^{252}Cf source-driven noise-analysis measurements of the subcritical neutron multiplication factor k for a wide variety of fissile systems with k varying from ~0.3 to ~0.999. A more general conclusion is that formulas derived from the point reactor model should be based on assumptions concerning detection that are consistent with the actual three-dimensional structure of the measurement setup. Results are presented for an experiment that employed multiple pairs of detectors. Data from the pairs positioned far from each other agreed with the modified point reactor model, while data from the other pairs close to each other and the source required different assumptions about the detection process to yield the correct multiplication factor.

12798 (ENET–8900475/1) **Determination of delayed neutron fraction: Application to the CROCUS reactor.** Decurnex, Ch. (Ecole Polytechnique de Lausanne, Inst. de Genie Atomique, Lausanne (Switzerland)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Sep 1989. 17p. (In French). Order Number DE91623398. Source: OSTI; NTIS (US Sales Only); INIS.

ENET, Elfenauweg 29, CH-3006 Bern.

A calculation method for kinetic parameters of a reactor which does not use calculation of adjoint fluxes has been developed. The study led in particular to the calculation of the delayed neutron fraction, by several variants of the proposed method. The numerical application of this method was compared to the standard method for the CROCUS reactor of IGA. The results obtained were satisfactory. 4 figs., 4 tabs., 4 refs.

12799 (INIS-mf–12781, pp. 182-186) **Current version of APRO program for parametrization of variables.** Vlachovsky, K. (Skoda, Plzen (Czechoslovakia)). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The program APRO, used for parametrization of MAGDA type group constant libraries, is described. It has four major functions: reading of input variables in the calculation points, organization of variables, calculation of additional variables and determination of weight factors, and calculation of the approximation parameters. The program APRO receives data from microconstant calculation programs (e.g. WIMS), processes the data, and transmits the result - the approximation parameters -to diffusion codes (e.g. MOBY-DICK). The program satisfies the requirements that were set during its formation: universality, adequate rapidity and easy handling. (Z.M.). 2 refs.

12800 (KFK–4779) **A new simplified method to calculate the streaming reactivity for pin lattices of fast reactors.** Fischer, E.A. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheitsforschung. Dec 1990. 41p. Order Number DE91759549. Source: OSTI; NTIS (US Sales Only); INIS.

A formalism developed by Benoist, to calculate the neutron leakage in a voided fast reactor lattice, was modified and simplified using analytic chord length distributions. The new method (computer routine ARIADNE) allows for a rapid calculation of buckling-dependent anisotropic cell diffusion coefficients for voided and unvoided periodic lattices with adequate accuracy. Results are compared with Monte Carlo calculations carried out at ANL, and with results from other authors. (orig.).

12801 (PSI–71, pp. 23-39) **Improvements in the prediction of LWHCR lattice parameters.** Boehme, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Axmann, J.; Broeders, C.H.M.; Palloni, S.; Schatz, M. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1990. In *Contributions to technical and economic aspects of high converters.* 62p. Order Number DE91003073. Source: OSTI; NTIS (US Sales Only); INIS.

The current series of experiments for the investigation of the physics of a light water high conversion reactor (LWHCR) has been

in progress at the PROTEUS reactor facility in Switzerland since 1985. Reaction rate ratio and k_{∞} measured in these thermally driven LWHCR lattice experiments were predicted by several institutes participating in this program. The development of suitable calculational methods and the introduction of new cross-section sets based on the nuclear data files JEF-1 and KEDAK-4 have reduced the differences between calculated and measured k_{∞} values, but discrepancies between some of the measured reaction rate ratios and calculations are still considerable. It has been shown that deficiencies in nuclear data as well as inaccuracies in the treatment of resonance absorption could be responsible for these discrepancies. (author) 4 figs., 23 refs.

2202 Components and Accessories

Refer also to citation(s) 12635, 12636, 12693, 12846, 12865, 13355

12802 (CEA-DAS–744) **Goals, organisation and means of the french IPSN emergency technical center.** Chauliac, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Manesse, D.; Crabol, B.; Ney, J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 12p. (CONF-900980–: 3. ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century, Lyon (France), 23-28 Sep 1990). Order Number DE91757100. Source: OSTI; NTIS (US Sales Only).

In France, in case of an accident in a nuclear installation, a national emergency organization would be set up. It involves close collaboration between the safety authorities and the operating utility. The above arrangement consists mainly in a decision-making level (the Emergency Centre of the SCSIN) and a think tank (the Emergency Technical Centre of the IPSN). During the early phase of the accident (corresponding to the off-site emergency response plan, or PPI in french), the IPSN Emergency Technical Center (ETC) is organized round a management unit receiving analysis data from two working parties, one studying the situation within the damaged plant (plant assessment unit) and the other concerned with assessing the radiological consequences of the accident (radiological consequence unit). During the intermediate phase of the accident (corresponding to the off-site post-accident response plan, or PPA in french), the plant assessment unit is removed from the organization and the radiological consequence unit is transformed in a post-accident unit with the presence of new experts in the fields of agriculture, hydrology, hydrogeology,.... In both phases, an other unit of the ETC (the operational unit) is in charge of the coordination of the intervention means of the CEA which are, on request, placed at the public authorities disposal.

12803 (ETDE-IT–91-17) **Modified standard method for flux perturbation analysis.** Gandini, A.; Sargeni, A.; Pregagnoli, C. ENEA, Rome (Italy); Rome Univ. (Italy). 1990. 10p. (CONF-900418–17: International conference on the physics of reactors: operation, design and computation, Marseilles (France), 23-27 Apr 1990). Order Number DE91752937. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at International conference on the physics of reactors: Operation, design and computation (Marseille, 23-26 Apr 1990).

In the process of analysis of a reactor design, it is essential to express the physical quantities of interest (generally, functionals of the flux function or response) in terms of system parameter changes. This need has led in the past to a variety of perturbation, or sensitivity techniques, of first and higher orders. These techniques, however, prove to require the calculation of a rather larger number of eigenfunctions if the perturbations are strong and localized, as is the case when searching for the flux distribution following a significant alteration of the control elements. If a two dimension approximation is adopted, the number of eigenfunctions required may become prohibitively large. In certain circumstances the incompleteness of the eigenfunctions can be also related to the vanishing in some zones of the coefficient multiplying the eigenvalue, e.g., in the case of lambda-type eigenvalues, to the vanishing in some zones of the macroscopic fission cross-section. This may occur, in particular, within the control channels. If the effects of control element alterations have to be analysed, some difficulty may then arise. To overcome this problem, a modified standard method (MSM) is here considered which should also allow a perturbed flux calculation with a reasonably small number of eigenfunctions.

12804 (EUR–12819) **Thermochemical data for reactor materials.** Ronchi, C. (Commission of the European Communities Karlsruhe (DE). European Inst. for Transuranium Elements); Turrini, F. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 190p. Source: OSTI; NTIS (US Sales Only).

This report describes a computer database of thermochemical properties of nuclear reactor materials to be used for source term calculations in reactor accident codes. In the first part, the structure and the content of the computer file is described. In the second part a set of thermochemical data is presented pertaining to chemical reactions occurring during severe nuclear reactor accidents and involving fuel (uranium dioxide), fission products and structural materials. These data are complementary to those collected in the databook recently published by Cordfunke and Potter after a study supported by the Commission of the European Communities. The present data were collected from review articles and databanks and follow a discussion on the uncertainties and errors involved in the calculation of complex chemical equilibria in the extrapolated temperature range.

12805 (EUR–12875) **Behaviour of actinides and other radionuclides that are difficult to measure in the melting of contaminated steel.** Schuster, E. (Siemens A.G. Erlangen (DE)); Haas, E.W. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 39p. Contract FI1D - 0044. Source: OSTI; NTIS (US Sales Only).

The research work carried out confirmed the expected homogeneous distribution of the radionuclides selected for the experiments (Fe 55 and Ni 63) in the metal ingot, as was already known from the behaviour of Co 60. The latter radionuclide may be used as an indicator nuclide for Fe 55 and Ni 63 which are both difficult to measure. C 14 also showed homogeneous distribution in the ingot (carbon steel). As expected for the melt technique strontium is released to the slag. In principle this is valid for actinides too, but depends to some extent on their chemical form (elemental uranium, UO_2), the added tracer quantity and the quantity of slag forming material. A direct alpha-measurement technique has been developed for steel samples and may be suitable for free release measurements of alpha-emitting steel waste decontaminated by the melt technique.

12806 (EUR–12947) **Investigation of specific applications of laser cutting for dismantling of nuclear power plants.** Migliorati, B. (FIAT, Turin (IT). Sezione Energia Nucleare); Tarroni, G.; Difino, M.; Picini, P.; Manassero, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 137p. Contract No FI1D-0014-I. Source: OSTI; NTIS (US Sales Only).

The aim of this work, performed on an experimental basis in a frame of strict collaboration between industry (Fiat-CIEI and Fiat-CRF in Turin) and public research laboratories (ENEA-PAS-FIBI in Bologna, ENEA-PAS-ISP and ENEA-TIB-TECNLAS in Rome) and supported by a CEC contract, was to bring out the items for better evaluation of the laser beam application possibilities in dismantling nuclear power plants. The main topics of the research have been: (i) study and definition of the relevant basic parameters ruling the aerosol generation rate and behaviour in terms of physical and chemical characteristics. This work has been performed in a facility specifically designed for aerosol measurements and equipped with a 2kW laser source; (ii) study of the feasibility of local abatement of the aerosols produced and of the pressure drop in the HEPA filters; (iii) study of long-distance transmission of the laser beam power performed with a 5KW laser source with an evaluation of the power loss and beam characteristic modifications; (iv) study of laser beam technique application for dismantling the Garigliano power plant steam drum in order to better demonstrate the feasibility of the use of this technique. The research resulted in the conclusion that the laser beam is actually appropriate for long-distance dismantling of metal components. Although the main aspects of the laser cutting

process have been examined, some problems remain to be investigated. This could be performed, after proper cost-benefit evaluation, during a future decommissioning programme.

12807 (EUR–13056) **Periodic safety re-evaluations in NPPs in EC member states, Finland and Sweden.** Commission of the European Communities, Luxembourg (Luxembourg). 1990. 25p. Source: OSTI; NTIS (US Sales Only).

The work on periodic safety re-evaluations summarized in this report was performed by a Task Force of the CEC Working Group on the Safety of Thermal Reactors. The periodic safety re-evaluations under review in this study were those that are carried out in addition to other reviews which represent the primary means of safety assurance. The periodic safety re-evaluation is broader and more comprehensive in nature. The cumulative effects of experience (national and international), advances in knowledge and analysis techniques, improvements in safety standards and operating practices, overall effects of plant ageing, and the totality of all modifications over the period in question need to be taken into account. All countries have recognized the value of such periodic reviews, and licensees, either as a regulatory requirement or as a voluntary action, are carrying them out. The scope and contents of each country's review showed many similarities of approach, any differences being explained by the age and type of reactor in operation. Many similarities emerged in the topics selected for re-evaluation and in the approach to re-evaluation itself. The overall conclusion was that while approaches may differ in some respects, for practical purposes comparable levels of safety are achieved in the periodic safety re-evaluation of nuclear power plants.

12808 (INIS-mf–12781, pp. 36-41) **Results of R+D of 1000 MW turboalternator.** Hlavac, J. (Skoda, Plzen (Czechoslovakia). Elektrotechnicky Zavod). Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

The results of R+D activities associated with the design of a 1000 MW turboalternator are summarized. Attention is paid to problems of electromagnetic fields, loss removal, dielectric strength, electrodynamic forces, mechanical strain, dynamics, excitation and diagnostics. It is concluded that from the technical aspects, the turboalternator will compare well with products by foremost foreign manufacturers. (Z.M.). 5 figs.

12809 (INIS-mf–12781, pp. 42-47) **Probabilistic methods of technical diagnostics based on expert knowledge.** Jirousek, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Teorie Informace a Automatizace); Kriz, O. Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti. Jun 1989. 201p. (In Czech). (CONF-8906314–: Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors, Karlovy Vary (Czechoslovakia), 6-9 Jun 1989). In *Results of R+D of nuclear power plants with WWER-1000 type light-water reactors. Part 2.* Order Number DE91622762. Source: OSTI; NTIS (US Sales Only); INIS.

A brief overview is given of the premises and theoretical starting points of various decision models that operate with the expert knowledge notion and are well suited to technical diagnostics purposes. With regard to their assets, probabilistic methods receive particular attention. It is demonstrated why expert systems are only suitable for consultations while the final decision must always (especially in vital problems) be left to man. (Z.M.). 1 fig., 23 refs.

12810 (INIS-mf–12796, pp. 179-188) **Electrical equipment diagnostics - unavoidable activity in securing safe and reliable operation of nuclear power plants.** Murin, M. (Atomova Elektraren Bohunice, Jaslovske Bohunice (Czechoslovakia)); Jakabovic, M. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Slovak). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Some electrical equipment diagnostic methods were unknown in Czechoslovakia and are now being gradually introduced. Since 1980, several major failures of the main generation and distribution equipment that could not be detected during conventional in-service inspections have been discovered. They included failures of current connections of transformer windings and current connections of transformer taps, faults of turbine alternators, cableways and storage batteries. The diagnostic methods included thermovision, measurement of the insulation system, measurement of idle characteristics, short-circuit response, measurement of rotor impedance, gas chromatography of transformer oils, spectral analysis of casings and vessels, measurement of the dew point and relative humidity, and measurement of vibrations. The new methods introduced include measurement of aerosols and of concentrations of other chemical compounds in the cooling media and measurement of discharges. The facilities tested were turbine alternators, power transformers, bushings, cables, external 220 and 110 kV switch plants and internal 6 and 0.4 kV switch plants, batteries, and selected electrical drives. (M.D.).

12811 (NUREG/CP–0111, pp. 273-287) **Diagnostics of stroke timing test for power operated valves.** Galbreath, G.; Witherspoon, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

The paper provides a historical perspective of the application of valve stroke timing since the early 1970s and how the issues have evolved. An assessment of how effective valve stroke timing is in finding and predicting problems is discussed. Research findings will be presented regarding the complete test and maintenance history of a small, random sample of different types of valves, highlighting where the industry may be heading in the future.

12812 (NUREG/CP–0111, pp. 309-316) **Panel discussion: [inservice testing] IST of valves; experience and lessons learned.** Sullivan, T.; Rothberg, O.; McLean, S.; Higgins, J.; Ozol, J.; Witherspoon, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

This is a record of a question and answer session discussing the experience and lessons learned in inservice testing (IST) of valves. Areas of discussion include the relationship between US NRC generic letter (GL) 89-10 and GL89-04, alternatives to stroke testing, check valve inspection, vortex shedding on check valves, check valve disassembly, flow test at check valves, radiographing valves, oversize check valves, and detection of check valve failures.

12813 (NUREG/CP–0111, pp. 319-327) **Digital computer analysis of inservice testing data in accordance with ASME code.** Nicholas, J.R. Jr. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

Inservice Testing (IST) requirements for nuclear powered generating plants demand accuracy and attention to detail in order to meet regulatory standards and to avoid unnecessary plant shutdowns. The use of computers and microprocessor-based data collectors can be extremely helpful in eliminating human error. The primary functions of the hardware are to effectively collect, transfer, analyze, trend and archive the thousands of bytes of data generated in performing these tests. This paper will discuss electronically managing IST data and illustrate how human error can be reduced

by systematic programming of the entire process using technology which is currently available.

12814 (NUREG/CP–0111, pp. 335-345) **Advanced valve motor operator diagnostic system [motor current signature analysis] M.C.S.A/[valve motor operator diagnostic system] VMODS.** Thibault, C. (Lyle Labs., West Huntsville, AL (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation: EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

This paper explains Wyle's new system for diagnostics, signature analysis and direct measurement of actual load on Motor Operated Valves (MOV) in the closed direction. The following topics are discussed: System description, System capabilities, and Features. The specific features of Wyle's system are: Measures directly the actual closing force; Easy to install; Leap frog working feature minimizes test time; Capability of up to 14-channel simultaneous input and acquisition; Non-intrusive monitoring at a remote location [motor control center (MCC)]; High sensitivity and selectivity to a variety of mechanical disorders affecting MOV operational readiness; and Provision of useful and trendable signature features.

12815 (NUREG/CP–0111, pp. 359-377) **Assessment of the effectiveness of ASME Section XI pump and valve surveillance testing.** Hosler, J.F. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation: EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

The effectiveness of the pump and valve surveillance testing currently performed in accordance with ASME Section XI requirements was assessed. The assessment was based on a pilot comparison of actual in plant Section XI testing results to reported component degradation/failure histories obtained from NPRDS for two nuclear units over a period of four years. An evaluation was performed on a component by component basis evaluating Section XI testing results, i.e., measured stroke times, vibration levels, etc., for all pumps and valves for which component degradations/failures were reported. The intent was to determine the extent to which specific testing methods actually detected or predicted specific component degradation types. The statistical data base (two plants over four years) was insufficient to allow firm conclusions. However, the results do provide an indication of the effectiveness of specific Section XI tests in detecting/predicting specific degradation/failure types. The seat leakage testing for valves was found to be effective in detecting existing degradation but could not be trended to predict future leak rates. Stroke time testing of motor and air operated valves was, in general, ineffective in either detection of existing degradation or prediction of incipient failure. Vibration testing (displacement) of pumps was found to be somewhat effective in both detection and prediction of high vibration levels. Likewise, DP/Flow testing was found to be somewhat effective in detecting low flow conditions. However, no assessment could be made regarding the relationship between a low flow test result obtained under mini-flow conditions and actual pump degradation. The data were insufficient to assess the effectiveness of DP/Flow testing in predicting future flow anomalies.

12816 (NUREG/CP–0111, pp. 379-388) **Motor operated valve stroke timing; is there value?.** Green, K.; Rosch, F. Jr.; Neckowicz, T. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609;CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

Both ASME Section XI, Subsection IWV and ASME/ANSI OMa-1988, Part 10 require stroke timing of certain power operated valves. This requirement is intended to detect valve degradation and subsequent maintenance, repair or replacement needs. However, the adequacy of stroke timing, especially for motor operated valves, has met much skepticism in the industry. This paper will demonstrate that stroke timing for ac motor operated valves is inadequate and provide a non-intrusive testing alternative. It will also discuss the value of stroke timing for dc motor operated valves.

12817 (NUREG/CP–0111, pp. 437-440) **A photoelectrically actuated, motor-operated valve stroke timer.** Wohld, P.R. (Chicago Nuclear Corp., Glen Ellyn, IL (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation: EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

Questions have been raised about the value of Motor-Operated Valve (MOV) stroke timing in nuclear power plants, and, reevaluations of requirements in this area have recently been done by the ASME O&M Committee Working Group on Pumps and Valves. Quoting an August 12, 1988, submittal to the Committee by W.L. Greenstreet from Oak Ridge National Laboratories, stroke time data, if made more Precise and carefully analyzed, can yield valuable operational readiness and diagnostic information. This paper presents a battery-powered, photoelectrically actuated timer developed by the Chicago Nuclear Corporation for precision MOV stroke timing. The timer receives input from valve position indicating lights on the main control panel and can easily be used with existing plant procedures. The paper also describes analysis and evaluation techniques to be applied to the data in monitoring valve operability. The techniques described apply the data to specific valve operator characteristics, thereby increasing the quality of MOV operability assessments. Both ac and dc motor operators are considered.

12818 (NUREG/CP–0111, pp. 457-465) **Acoustic/magnetic test techniques for verifying operation of check valves.** McElroy, J.W. (Philadelphia Electric Co., PA (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation: EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. (EGG–2609:CONF-890852–: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC (USA), 1-3 Aug 1989). In *Proceedings of the symposium on inservice testing of pumps and valves.* 469p. Source: OSTI; INIS.

Recent operating events involving check valve failure in the nuclear power industry have raised specific issues on how to verify operability of check valves by inspection. Philadelphia Electric has had a program to develop test techniques and procedures that can be used to address those specific inspection issues. This paper discusses acoustic and magnetic techniques used to measure check valve disk motion and internal impacts resulting from the disk motion. Full stroke capability, internal worn parts, excessive fluttering, leak tightness are all detected and confirmed by the acoustic and magnetic techniques. These testing techniques can be used to address certain INPO SOER 86-03 and ASME code Inservice Testing requirements.

12819 (SAND–91-0187C) **Mechanical property condition monitoring of cables exposed to long- term thermal and radiation aging: XLPO results.** Jacobus, M.J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 12p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910426–1: Nuclear power plant and facility maintenance topical meeting, Salt Lake City, UT (USA), 7-11 Apr 1991). Order Number DE91009174. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories is conducting long-term aging research on representative samples of nuclear power plant Class 1E cables to determine the suitability of these cables for extended life (beyond the 40-year design basis) and to assess various cable condition monitoring techniques for predicting remaining cable life. This paper provides some results of mechanical measurements that were performed on cross-linked polyolefin (XLPO) cables and cable materials aged at relatively mild, simultaneous thermal and radiation exposure conditions for period of up to nine months. The mechanical measurements discussed in this paper include tensile strength, ultimate elongation, hardness, and compressive modulus.

The modulus measurements were performed using an indenter developed at Franklin Research Center under EPRI sponsorship. 10 refs., 23 figs., 2 tabs.

2203 Fuel Elements

Refer also to citation(s) 12660, 12804, 13232

12820 (GA-A–20335) **TFE Verification Program semiannual report for the period ending September 30, 1990.** General Atomics, San Diego, CA (USA). Jan 1991. 120p. Sponsored by USDOE,. DOE Contract AC03-86SF16298. Order Number DE91008630. Source: OSTI; NTIS; GPO Dep.

The program objective is to demonstrate the technology readiness of a TFE suitable for use as the basic element in a thermionic reactor with electric power output in the 0.5 to 5.0 MW(e) range, and full-power life of 7 years. The objective of the semiannual progress report is to summarize the technical results obtained during the latest reporting period. The information presented in this paper will include evaluated test data, design evaluations, the results of analyses and the significance of results.

12821 (IAEA-TECDOC–577, pp. 97-103) **Research on uranium-silicide nuclear fuel.** Kolyadin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii): Dubrovin, K.P.; Pavlenko, V.I.; Kruglov, A.V.; Medvedev, A.V.; Borisov, K.A.; Konovalov, I.I. International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

This paper gives the results of reactor test and the subsequent investigations of silicide fuels U_3 Si in hot cells. To compensate for swelling fuel rods had differently shaped voids: a central hole, circular or longitudinal grooves. During testing the release of fission products from leakers was also studied. (author). 2 tabs.

12822 (IAEA-TECDOC–577, pp. 69-72) **Status of advanced fuel in India.** Narayanan, P.S.A. (Nuclear Fuel Complex, Hyderabad (India)). International Atomic Energy Agency, Vienna (Austria). Nov 1990. (CONF-8911279–: Advisory group meeting onadvanced fuel technology and performance: current status and trends, Vienna (Austria), 27-29 Nov 1989). In *Advanced fuel technology and performance: Current status and trends: Proceedings of an advisory group meeting held in Vienna, 27-29 November 1989.* 126p. Order Number DE91622746. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the modifications done in the water reactor fuels to improve the performance and work done on mixed oxide, carbide and nitride fuels, SGMP fuel for fast reactor. Work done on U^{233} fuel also is indicated. Reactor performance and programmes are mentioned. Work being done in the reprocessing of fast reactor fuel is also indicated. (author).

2204 Control Systems

12823 (CEA-DAS–729) **Balance between automation and human actions in nuclear power plant operation. Results of international cooperation.** Sun. B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses. 92 (FR). Dept. d'Analyse de Surete): Bastl. W.; Olmstead. R.; Oudiz. A.; Jenkinson. J.; Kossilov. A. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses. 92 (France). Dept. d'Analyse de Surete. 1990. 32p. (CONF-900710–: IAEA symposium on balancing automation and human action in nuclear power plants, Munich (Germany, F.R.), 9-13 Jul 1990). Order Number DE91752702. Source: OSTI; NTIS (US Sales Only).

Automation has long been an established feature of power plants. In some applications, the use of automation has been the significant factor which has enabled plant technology to progress to its current state. Societal demands for increased levels of safety have led to greater use of redundancy and diversity and this, in turn, has increased levels of automation. However, possibly the greatest contributory factor in increased automation has resulted from improvements in information technology. Much recent attention has been focused on the concept of inherently safe reactors, which may simplify safety system requirements and information and control system complexity. The allocation of tasks between man and machine may be one of the most critical activity in the design of new nuclear plants and major retro-fits and it therefore warrants a design approach which is commensurate in quality with the high levels of safety and production performance sought from nuclear plants. Facing this climate, in 1989 the International Atomic Energy Agency (IAEA) formed an advisory group from member countries with extensive experience in nuclear power plant automation. The task of this group was to advise on the appropriate balance between manual and automatic actions in plant operation.

12824 (SIEMENS-KWU-B–313-90/e148) **Numerical simulation of nuclear power plants on multiprocessor systems. Final report.** Boeer. R.; Finnemann, H.; Mueller, R.; Krapf, J. Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.). Bereich Energieerzeugung: Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1990. 44p. Contract BMFT ITR 8502 MO. Order Number DE91756650. Source: OSTI; NTIS (US Sales Only); INIS.

The present final report gives an account of work performed and results obtained at Siemens/KWU within the frame of SUPRENUM project. The coupled neutron kinetics - thermal hydraulics program system 3D-SIM for the calculation of steady-state and transient conditions in the core and in the coolant loops of light water reactors has been developed. Making efficient use of the parallel computing architecture required the implementation of novel, purpose-built software concepts which can be characterized by multigrid algorithms and parallelization by domain decomposition. The modules treating the reactor core are 3D-NEUT for neutron kinetics and 3D-THERM for thermal hydraulics, the remaining system and control components being represented by the module NLOOP. This modular structure is a main feature of 3D-SIM which allows a flexible choice of applications, employing modules individually or in combinations to fulfil a specific calculation task. In particular, 3D-SIM reactor core representation is fully 3-dimensional for both neutron diffusion and thermal-hydraulic equations, allowing coupled calculations and evaluation of crossflow between fuel elements or subchannels. Including also the loops and plant models, 3D-SIM is a powerful analytical tool for simulating pressurized plant response to a wide spectrum of events. (orig.) With 25 refs., 11 figs.

12825 (WSRC-MS–90-341) **A simple total loss of heat sink fix for a Singer-Link simulator.** Gregory, M.V. Westinghouse Savannah River Co., Aiken, SC (USA). [1991]. 6p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. (CONF-910468–5: 1. annual international simulators conference, New Orleans, LA (USA), 1-5 Apr 1991). Order Number DE91009293. Source: OSTI; NTIS; GPO Dep.

The Savannah River Simulator is a middle 1980's vintage full-scope training simulator. Recent exercises in the loss of heat sink regime have revealed significant short-comings in the hydraulics models for the secondary side of the plant: the software sets up flow oscillations as the zero flow condition is approached, and the algorithm is unable to produce the expected core heat up. Exceedingly simple modifications in the pressure iteration algorithm and the heat exchanger model have been found to completely cure the problems. The pathological response and the ensuing fix may be of interest to any other proprietors of simulators of similar vintage which may utilize a similar hydraulics model. 1 ref., 3 figs.

12826 (WSRC-TR–90-14) **Design features for a new deltaK rod.** Baumann, N.P. Westinghouse Savannah River Co., Aiken, SC (USA). Feb 1990. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91007902. Source: OSTI; NTIS; GPO Dep.

DeltaK rods have been used to measure temperature coefficients of reactivity in operating reactors. These are designed to give a near instantaneous step increase of reactivity in a stable reactor at power about 15% below its operating limit. Analysis of the resulting power transient as recorded by various neuron flux monitors provides individual temperature coefficients for the bulk moderator and for the combined coolant metal. The last of these old rods was

discarded many years ago. Interest has now been raised for reinitiation of these tests. Simply refabricating rods of the earlier design is no longer practical and it is now necessary to provide a suitable new design. Boron-loaded stainless steel makes an excellent substitute for the cadmium of the earlier tests. The studies indicate that a design choice should be made from one of three choices. Each design has its own virtues and the best choice depends somewhat on assumptions regarding likely operational constraints. All of the designs would be powered by digitally controlled motors. Data acquisition and data analysis are not considered in this report. These should pose no problem, inasmuch as they involve standard equipment and techniques already well in hand. 8 refs., 4 figs., 3 tabs.

2205 Environmental Aspects

Refer also to citation(s) 13513, 13582

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 12571, 12671, 12672, 12673, 12674, 12675, 12676, 12677, 12678, 12679, 12680, 12681, 12682, 12683, 12684, 12685, 12686, 12687, 12688, 12689, 12690, 12691, 12692, 12769, 12798, 12832, 12833, 12834, 12841, 12842, 12852

12827 (INIS-GB–302) **Annual report 1989-90.** Universities Research Reactor, Risley (UK). 1990 27p. Order Number DE91623440. Source: OSTI; NTIS (US Sales Only); INIS.

It is reported that, as well as a strong demand for the use of the reactor and site facilities, the closure of the Harwell reactors has provided new work, in particular in the provision of isotopes for medical purposes. Teaching and activation analysis have been major elements in the programme. Brief details of the research programme, activation analysis, teaching and reactor operation and safety over the year are given. (UK).

12828 (JAERI-M–90-103, pp. 154-163) **Study of fission products redeposition by comedie loop in the experimental SILOE reactor.** Veyrat, J.F. (CEA Centre d'Etudes Nucleaires de Grenoble. 38 (France)); Bastien, D. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies. Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

CEA has a long national and international experience in the field of experimental irradiations. It is operating two experimental reactors OSIRIS (Saclay/France) and SILOE (Grenoble/France), in which a large number of devices and loops about the different reactors systems used through the world are irradiated. For HTGR Studies, a COMEDIE helium loop has been built to study the release and deposition of fission products from the fuel. A modification of this loop, to be able to do in situ blow down tests to study fission products lift off, is in progress. Around the loop itself, continuous fission gas analysis is feasible in a special equipped Fission Gas Analysis Laboratory. Post-Irradiation Examinations can be conducted in hot cells, located close to the reactor itself. (author).

12829 (JAERI-M–90-103, pp. 164-183) **Design and safety considerations in the Japanese High-Temperature Engineering Test Reactor (HTTR).** Saito, Shinzo (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The HTTR is a high temperature gas cooled test reactor with thermal out-put of 30 MW and maximum reactor outlet coolant temperature of 950degC, aiming at establishing and upgrading the technology basis for advanced HTGRs and performing various innovative high temperature basic researches. This paper describes the design of the HTTR specifically focussing on design considerations for achievement of 950degC outlet gas temperature and safety considerations in the design. The paper also describes briefly safety evaluation of the HTTR and its construction schedule. The HTTR is the first HTGR in Japan and will be the first HTGR in the world which provides high temperature gas higher than 800degC outside the reactor vessel. Therefore, various considerations were taken in the design to achieve reactor outlet coolant temperature of 950degC in the HTTR. Due considerations were made how to minimize the maximum fuel temperature, how to reduce the coolant flow rate ineffective to cool the fuel, how to minimize thermal and irradiation stresses of graphite block, how to resolve the problems relevant to high temperature and high pressure in the primary cooling system design, and so on. Several important safety considerations for fuels, reactor shut-down system, back-up reactor cooling system, multiple barriers against FP release, etc., were also adopted in the design of the HTTR. These elaborate considerations in the design of the HTTR together with extensive research and development make it possible to produce and take out very high temperature helium gas up to 950degC outside the reactor vessel in the HTTR. The safety review of the HTTR by the government is presently underway. Construction is scheduled to start in 1990 and first criticality is expected in 1995. (author).

12830 (JAERI-M–90-103, pp. 300-318) **Research and development related to licensing of HTTR.** Yasuno, Takehiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The research and development on HTGR in Japan Atomic Energy Research Institute (JAERI) were initiated by the program of the experimental very high temperature reactor (VHTR) in 1969. According to the experimental VHTR program, the various kinds of research and development works were started at that time for the experimental VHTR construction. The items of research and development were design study of the experimental VHTR, material research, developments on helium engineering and construction of large test rig. Through the design study of the experimental VHTR, the survey of the technology to be developed and the basic data for VHTR design and construction, was performed to complete the research and development plan. In 1987, the construction of the HTTR was decided instead of the experimental VHTR by the revision of the Long-Term Program for Development and Utilization of Nuclear Energy. According to this new program, JAERI plan of research and development was reviewed and supported the conclusion that no large modification of the existing plan was necessary. JAERI was carrying out various kinds of research and development for the HTTR licensing and construction. These works were conducted in the Oarai in-pile Gas Loop, the Helium Engineering Demonstration Loop, Very High Temperature Reactor Critical Assembly and the others for long time. This report covers research and development works performed for the HTTR licensing and construction. (author).

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 12571, 12825, 12840, 12844, 12850, 12851, 12869, 12870, 12871, 13323

12831 (DPST–86-244) **Preliminary C-tank thermal analysis comparison with Westinghouse results.** Hamm, L.L. Savannah River Lab., Aiken, SC (USA). 21 Jan 1986. 12p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract AC09-76SR00001 :AC09-89SR18035. Order Number DE91008126. Source: OSTI; NTIS; GPO Dep.

With respect to the repair of cracks in the C reactor vessel and as a preliminary step in the quality assurance process of the Westinghouse patch performance calculations, a comparison of a chosen test case to the Savannah River Lab. (SRL) calculations is made. The test case chosen represents normal full power operation followed by a typical winter scram. The thermal predictions made by W and SRL are compared at various selected segments of the patch and tank wall within the knuckle region. Within each segment averaged temperature values at various points in time are compared. A 5% maximum discrepancy in predicted segment temperatures exist between the W and SRL thermal-analyses. Several modeling differences are present and are mentioned in this report. The major contribution to the temperature discrepancies is the result of different techniques employed in numerically handling the spatial variation in gamma heat generation. The other differences are secondary. Since the discrepancies experienced are explainable, a necessary verification link between the W and SRL algorithms is established. The coarse discretization of the mesh and the gamma heating distribution made in the W model introduces errors. However, these errors appear to be small and on the average conservative. Thus, the 3-D mesh chosen by W is adequate for predicting the transient cases of interest. Based on this comparison W is refining their mesh and heat generation technique. 5 figs., 4 tabs.

12832 (EUR–12727) **Neutron radiography at the HFR Petten.** Markgraf, J.F.W. (ed.). Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. 90p. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). Source: OSTI; NTIS (US Sales Only).

This report contains the five papers on neutron radiography activities at the Petten High Flux Reactor (HFR) presented at the Third World Conference on Neutron Radiography which was held in May 1989 in Osaka, Japan. In addition, a survey on neutron radiography in Europe for industry and research as presented at the SITEF NDT symposium 1989 on European Advances in Non-Destructive Testing, held in Toulouse/France in October 1989 is included. The papers compiled here are concerned with: . the neutron radiography services available in Petten, . the experience with and applications of neutron radiography at Petten, . image evaluation and analysis techniques at Petten, . the practical utilization of nitrocellulose film in neutron radiography in Europe, . an introduction into the basic principles of neutron radiography, . an overview of the neutron radiography facilities in Europe for industry and resarch and . a survey of typical applications of neutron radiography in industry, research and sciences. It is the intention of this compilation to provide a comprehensive overview of the present Petten activities and European facilities in this young and promising field of non-destructive testing of materials and components from the nuclear and the non-nuclear industries and research organizations, and from the sciences.

12833 (EUR–12727, pp. 1-10) **The Petten neutron radiography services facilities and methods.** Markgraf, J.F.W. (Commission of the European Communities, Petten (NL). Joint Nuclear Research Center); Leeflang, H.P.; Van Otterdijk, K.H. Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

The Petten Neutron Radiography Services, PNRS, represent the joint Neutron Radiography (NR) facilities of the ECN and JRC at Petten. They comprise two NR-facilities at the High Flux Reactor (HFR) and one at the Low Flux Reactor (LFR), and a specialized NR-laboratory. NR-services are offered to nuclear and non-nuclear applications from Research and Industry. The NR-laboratory handles all kinds of NR-films and images. It employs equipment for dimensional, optical and image analysis. The contribution gives a survey of the PNRS, their NR-facilities and related techniques.

12834 (EUR–12727, pp. 11-22) **Experiences with the HB-8 facility at the Petten high flux reactor (HFR) for thermal and subthermal neutron radiography.** Leeflang, H.P. (Netherlands Energy Research Foundation Petten, (NL)); Van Otterdijk, K.H.; Bleeker, E.J.; Markgraf, J.F.W. Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

The neutron radiography facility HB-8 at the Petten High Flux Reactor (HFR) was originally built for thermal neutron radiography of spent fuel rods from power reactors. To cover the increasing demand for non-nuclear applications from industry and applied research, the facility has recently been modified and upgraded with a subthermal neutron beam. This was accomplished by means of a filtered beam, a Helium filled flight tube and an external exposure station.

12835 (HW–66767) **H area trip-out incident of March 11, 1960 potential ground failures.** Mollerus, F.J. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 22 Dec 1960. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009424. Source: OSTI; NTIS: GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS/ reactor operation; HAPO; FAILURES; OUTAGES; GEOLOGIC FAULTS

12836 (HW–67185) **Examination of process tube containing a molten lead-cadmium element (RM-405).** McMahan, M.E. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 21 Oct 1960. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009423. Source: OSTI; NTIS; GPO Dep.

In March 1960, two sections of a process tube (one coated a hole and the other had a fused area) were sent to Radiometallurgy Laboratory for examination. These sections showed the results of a melted lead-cadmium element (after the reduction of the coolant flow rate) from the 105-D Reactor.

12837 (JAERI-M–90-189) **The JMTR operation and technical development, 4.** Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 172p. (In Japanese). Order Number DE91755669. Source: OSTI; NTIS (US Sales Only); INIS.

The JMTR complex consists of a 50 MW high neutron flux reactor (JMTR; Japan Materials Testing Reactor), the irradiation facilities, a hot laboratory and nuclear critical assembly (JMTRC; Japan Materials Testing Reactor Critical Assembly). Many irradiation examination have been carried out by the capsules, hydraulic rabbit and loop facilities in the JMTR since 1971 when 50 MW high power operation started. These irradiation facilities have been fabricated, modified and replaced according to the needs of the times. And now, one high temperature gas loop (OGL-1, Oarai Gas Loop-1), two water loop (OWL-2; Oarai Water Loop-2, OSF-1; Oarai Shroud Facility), two hydraulic rabbit facilities and many capsules are in the JMTR. And post irradiation examination equipments have been developed according to the needs. This report describes the activities of JMTR Project performed in fiscal year 1989 as following: (1) The operation and management of the JMTR, Hot Laboratory and the JMTRC, (2) utilization status of the JMTR, (3) conversion to Low Enrichment Uranium Fuel, (4) fabrication, modification and replacement of the irradiation facilities and reactor core components, (5) development of the irradiation techniques and post irradiation examination techniques, (6) the fundamental studies to conduct irradiation techniques, (7) future program of the JMTR. (author).

12838 (JAERI-M–90-190) **Study on thermal performance of vertical gravity-assisted heat pipes for irradiation capsules.** Li Manchang (Southwest Centre for Reactor Eigineering Research and Design, SC (China)); Ito, Haruhiko; Siraishi, Tadao; Saito, Takashi; Amezawa, Hiroo; Itabashi, Yukio; Ichihashi, Yoshinori. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 40p. Order Number DE91755881. Source: OSTI; NTIS (US Sales Only); INIS.

The heat pipe has widely been used in various fields for many years. In order to use it for controlling temperature of the irradiation capsules in the JMTR, the thermal performance calculations for the wickless, the grooved and the homogeneous mesh wicked heat

pipes in the vertical gravity-assisted mode were made. The calculated results prove that the former two are preferable to be used at the high working temperatures (over 200degC) and the last one is better for being used at the low temperatures (below 120degC). All the calculated results, some analyses and discussions are presented in this report. (author).

12839 (ORNL/FTR–3866) **[HFR-B1 experiment reporting and capsule disassembly]: Foreign trip report, January 27, 1991–February 10, 1991.** Myers, B.F. Oak Ridge National Lab., TN (USA). 22 Feb 1991. 17p. Sponsored by USDOE. Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91008805. Source: OSTI; NTIS; GPO Dep.

The traveler visited the Joint Research Centre (JRC), Petten, The Netherlands, the Forschungszentrum GmbH (KFA), Juelich, Germany; and the Zentralinstitut fuer Kernforschung (ZfK), Rossendorf, Germany, during the period January 28 through February 9. At JRC, the analysis of the experiment HFR-B1 was discussed; a new schedule for issuance of the final data report was established. Other discussions at JRC concerned the capabilities of Petten to conduct two reactor experiments being proposed under the US/FRG cooperative program and the initial results of a proof test of Germany fuel spheres. At KFA, the main emphasis was on the disassembly of capsules 2 and 3 of the HFR-B1 experiment and agreement on the examinations and tests to be conducted with the disassembled components. The disassembly of capsule 3 was observed. Extensive discussions were conducted on the work, both experimental and analytical, being conducted in the Institut fuer Sicherheitsforschung und Reaktor Technologie. A major portion of the experimental work is being conducted at ZfK and a visit to this laboratory, sponosored by the KFA, was made on February 6 and 7. Cooperation with the US on the experimental and analytical work in the safety area was strongly emphasized. 1 tab.

2209 Reactor Safety

Refer also to citation(s) 12661, 12805, 12889, 13140, 13513, 13582

12840 (BNL–45155) **Computer analyses for the design, operation and safety of new isotope production reactors: A technology status review.** Wulff, W. Brookhaven National Lab., Upton, NY (USA). Jan 1990. 43p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91006911. Source: OSTI; NTIS; INIS; GPO Dep.

A review is presented on the currently available technologies for nuclear reactor analyses by computer. The important distinction is made between traditional computer calculation and advanced computer simulation. Simulation needs are defined to support the design, operation, maintenance and safety of isotope production reactors. Existing methods of computer analyses are categorized in accordance with the type of computer involved in their execution: micro, mini, mainframe and supercomputers. Both general and special-purpose computers are discussed. Major computer codes are described, with regard for their use in analyzing isotope production reactors. It has been determined in this review that conventional systems codes (TRAC, RELAP5, RETRAN, etc.) cannot meet four essential conditions for viable reactor simulation: simulation fidelity, on-line interactive operation with convenient graphics, high simulation speed, and at low cost. These conditions can be met by special-purpose computers (such as the AD100 of ADI), which are specifically designed for high-speed simulation of complex systems. The greatest shortcoming of existing systems codes (TRAC, RELAP5) is their mismatch between very high computational efforts and low simulation fidelity. The drift flux formulation (HIPA) is the viable alternative to the complicated two-fluid model. No existing computer code has the capability of accommodating all important processes in the core geometry of isotope production reactors. Experiments are needed (heat transfer measurements) to provide necessary correlations. It is important for the nuclear community, both in government, industry and universities, to begin to take advantage of modern simulation technologies and equipment. 41 refs.

12841 (CEAC-R–4-90) **Dynamical analysis of critical assembly CC-1.** Aleman Fernandez, J.R. (Centro de Estudios Aplicados al Desarrollo Nuclear (CEADEN), La Habana (Cuba)). Comision de Energia Atomica, La Habana (Cuba). 1990. 19p. (In Spanish). Order Number DE91623401. Source: OSTI; NTIS (US Sales Only); INIS.

The computer code CC-1, elaborated for the analysis of transients in Critical Assemblies is described. The results by the program are compared with the ones presented in the Safety Report for the Critical Assembly of "La Quebrada" Nuclear Research Centre (CIN). 7 refs.

12842 (CEAC-R–5-90) **Nuclear Research Center IRT reactor dynamics calculation.** Aleman Fernandez, J.R. (Centro de Estudios Aplicados al Desarrollo Nuclear (CEADEN), La Habana (Cuba)). Comision de Energia Atomica, La Habana (Cuba). 1990. 28p. (In Spanish). Order Number DE91623439. Source: OSTI; NTIS (US Sales Only); INIS.

The main features of the code DIRT, for dynamical calculations are described in the paper. With the results obtained by the program, an analysis of the dynamic behaviour of the Research Reactor IRT of the Nuclear Research Center (CIN) is performed. Different transitories were considered such as variation of the system reactivity, coolant inlet temperature variation and also variations of the coolant velocity through the reactor core. 3 refs.

12843 (CEA-DAS–724) **LMFBR: safety aspects.** Natta, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire). CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 23p. (In French). (CONF-9006321–: Scientical days. ASST, SIA, EPFL: nuclear energy, LMFBR and engineer ethics, Lausanne (Switzerland). 26-27 Jun 1990). Order Number DE91752699. Source: OSTI; NTIS (US Sales Only).

This presentation of LMFBR safety is limited at Super Phenix reactor. After a brief description of the reactor, some details on safety systems, in normal or accidental conditions, are given. The main functions studied are: chain reaction trip, residual power evacuation, reactor containment. In heavy accident the behaviour of Super Phenix is studied which its particular characteristics and the possibilities of operators reactions. The probability of appearance and the maximum consequences of heavy accidents are given.

12844 (CONF-910414–6) **A probabilistic method for evaluating reactivity feedbacks and its application to EBR-II.** Schaefer, R.W. Argonne National Lab., Idaho Falls, ID (USA). [1991]. 13p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. From International topical meeting on advances in mathematics, computations and reactor physics; Pittsburgh, PA (USA); 28 Apr - 2 may 1991. Order Number DE91007211. Source: OSTI; NTIS; INIS; GPO Dep.

The probability that reactivity feedbacks fail to prevent damage is computed by propagating data and modeling uncertainties through transient calculations, with these uncertainties being constrained by experimental evidence. Screening processes are used to identify the most important parameters and accident initiators. The response surface method is used to facilitate the error propagation and a Monte Carlo rejection technique is used to force the parameter variations to be consistent with the observed distribution of experimental quantities. The reliability of the failure probability estimates is evaluated. This process is applied to ATWS events in the PRA for the EBR-II reactor. The loss-of-normal-power (LONP), loss-of-flow and transient overpower accidents without scram were found to warrant detailed analysis and a complete analysis has been made for the first of these. Six parameters are primarily responsible for the LONP outcome variations. The conditional probability of minor core damage from LONP without scram is 1.2×10^{-2}. The uncertainty in this estimate is a factor of 2. This damage estimate would be an order of magnitude higher if experimental information about feedbacks in EBR-II was not used. the conditional probability of major core damage from LONP without scram is $<10^{-6}$. 20 refs., 1 fig., 3 tabs.

12845 (DOE/ID–10289(90)) **US Department of Energy Three Mile Island research and development program 1990 annual report.** EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract

AC07-76ID01570. Order Number DE91007908. Source: OSTI; NTIS; INIS; GPO Dep.

Defueling of the Three Mile Island Unit 2 (TMI-2) reactor was completed in 1990 as was transportation, receipt, and storage of TMI-2 core debris. The TMI-2 Technical Integration Office was closed March 1990. Completion, or significant progress toward completion, was logged in the remaining activities of the US Department of Energy (DOE) programmatic effort of support to cleanup the TMI-2 facility. This report discusses that work and other TMI-2 related cleanup, research, and development activities conducted during 1990. The major topics in this report include: waste immobilization; core debris transportation, receipt, and storage; accident evaluation program; and technical integration program. 2 figs., 1 tab.

12846 (DOE/NE/37968–T1) **DOE/NE University Program in robotics for advanced reactors research: Annual research progress report, January 1990–December 1990.** Trivedi, M.M. Tennessee Univ., Knoxville, TN (USA). Dept. of Electrical and Computer Engineering. [1990]. 44p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86NE37968. Order Number DE91008837. Source: OSTI; NTIS; INIS; GPO Dep.

The document presents the bimonthly progress reports published during 1990 regarding the US Department of Energy/NE-sponsored research at the University of Tennessee Knoxville under the DOE Robitics for Advanced Reactors Research Grant. Significant accomplishments are noted in the following areas: development of edge-segment based stereo matching algorithm; vision system integration in the CESAR laboratory; evaluation of algorithms for surface characterization from range data; comparative study of data fusion techniques; development of architectural framework, software, and graphics environment for sensor-based robots; algorithms for acquiring tactile images from planer surfaces; investigations in geometric model-based robotic manipulation; investigations of non-deterministic approaches to sensor fusion; and evaluation of sensor calibration techniques. (MB)

12847 (EUR–12884) **Environmental radioactivity Ispra 1989.** Dominici, G. (Commission of the European Communities, Ispra (IT). Joint Research Centre). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 60p. (In Italian). Source: OSTI; NTIS (US Sales Only).

In this report there are briefly described the measurements of environmental radioactivity performed during 1989 by the site survey group of the Radioprotection Division at the Joint Research Centre Ispra Establishment. Data are given on the concentrations of Sr-90, Cs-137, and other radionuclides in precipitation, air, waters, herbage, milk and radioactive effluents. The environmental contamination is mainly a consequence of the nuclear accident of Chernobyl.

12848 (GRS-F–182) **Surveys of research projects concerning nuclear facility safety, financed by the Federal Ministry for the Environment, Nature Protection and Reactor Safety, 1989. (14. annual report on SR-projects).** Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany, F.R.). Nov 1990. 221p. (In German). Order Number DE91759431. Source: OSTI; NTIS (US Sales Only); INIS.

Each progress report is a collection of individual reports, categorized by subject matter. They are a documentation of the contractor's progress, rendered by themselves on standardized forms, published, for the sake of general information on progress made in investigations concerning reactor safety, by the project attendance department of the GRS. The individual reports have serial numbers. Each report includes particulars of the objective, work carried out, results obtained and plans for project continuation. (orig.).

12849 (GSF–30/90) **EURALERT-79 user's guide. CEC-research programme 'Radiological aspects of nuclear accident scenarios'. Project 4: Development of a real-time dose response system including countermeasures.** Mueller, H.; Friedland, W.; Proehl, G.; Paretzke, H.G. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz. Sep 1990. 150p. Contract CEC BI-6-0255-D (AM). Order Number DE91759407. Source: OSTI; NTIS (US Sales Only); INIS.

EURALERT-89 is a dose assessment program system including countermeasures which has been developed in the framework of the C.E.C. research programme 'Radiological aspects of nuclear accident scenarios'. For this purpose the ECOSYS model for calculating the transfer of radionuclides through the environment, the contamination of foodstuffs and potential doses has been adapted to real-time use in the different European countries. In this user's guide the file names are given in the form SUBD/FNAM; this means that the data file with name FNAM is in the subdirectory SUBD. Remember that writing the path of a file depends on the computer used. With EURALERT-89 it is relatively simple to get an estimate of the most important informations (deposition, maximum specific activities in foodstuffs, most important dose values) for all locations which are included in the input file. This goal can be achieved with only a few commands. (orig./HP).

12850 (HW–72001) **Coolant flow stoppage incident, PRTR, November 9, 1961.** Richmond, W.D. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 12 Dec 1961. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009401. Source: OSTI; NTIS; GPO Dep.

On November 9, 1961, during flow flow shutdown conditions, a helium vapor lock occurred in the operating primary coolant pump which resulted in a stoppage of primary coolant flow to the reactor. The reactor had been shut down for nine days at the time of the incident and no damage to the fuel elements resulted.

12851 (HW–72405) **Temporary loss of coolant to PCCF tube 1890-D at D Reactor.** Baker, J.T. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 22 Jan 1962. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009403. Source: OSTI; NTIS; GPO Dep.

Coolants to empty PCCF tube 1890-D was interrupted for approximately thirty minutes during reactor operation on January 4, at D Reactor. Loss of coolant occurred when the inlet pigtail valve was placed in low flow position after turnaround poison had been flushed. Coolant was restored by returning the pigtail valve to high flow position. There was no interruption of reactor operation. Inspection of the pigtail valve during a subsequent outage revealed no drilled hole in the valve in low flow position. This valve was removed and a correct valve installed. Inspection of the process tube revealed no tube damage.

12852 (JAERI-M–90-103, pp. 241-271) **Key licensing safety issues and draft review results of High Temperature Engineering Test Reactor (HTTR).** Ibe, Yukimi (Science and Technology Agency, Tokyo (Japan)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies.* 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The HTTR is a test reactor with thermal output of 30 MW and outlet coolant temperature of 950 degC, employing pin-in-block type fuel blocks, and has the capability to demonstrate nuclear process heat utilization using an intermediate heat exchanger. Since 1986 the detailed designs have been made, in which major systems and components are determined in line with the HTTR concept. The application for the construction permit of the HTTR, which is the first HTGR in Japan, was submitted by the Japan Atomic Energy Research Institute (JAERI) to the Science and Technology Agency (STA) in February 1989. After about 10 months safety review, the STA concluded the draft of safety review results on the HTTR in December 1989, taking into consideration the unique features of the HTTR and has referred it to the Nuclear Safety Commission (NSC) for double-check safety review. This paper gives a brief presentation of the essential items on the results of safety review for the HTTR made by the STA, featuring and focusing on the major characteristics of the HTTR. (author).

12853 (JAERI-M–90-103, pp. 272-279) **Licensing overview of the Modular High Temperature Gas-Cooled Reactor (MHTGR).** Millunzi, A.C. (Department of Energy, San Francisco, CA (USA). San Francisco Operations Office): Mills, R.R.; Walker, L.P.; Funliffe, J.C.; Silady, F.A. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies*. 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

The MHTGR is an advanced reactor concept being developed under a cooperative program involving the U.S. Government, the nuclear industry, and the utilities. The design utilizes the basic HTGR features of ceramic fuel, helium coolant, and a graphite moderator. However, the specific size and configuration are selected to utilize the inherent characteristics of these materials to develop passive safety features that provide a significantly higher margin of safety than current generation reactors. Results to date indicate that the design will meet the U.S. Environmental Protection Agency's Protective Action Guidelines for ionizing radiation at the site boundary, hence precluding the need for sheltering or evacuation of the public during any licensing basis event. This safe behavior is not dependent upon operator action and is insensitive to operator error. This report discusses the MHTGR Licensing Plan. A discussion of the NRC preapplication phase review of the MHTGR is presented including a summary of the safety response to events challenging the functions relied on to retain radionuclides within the coated fuel particles. The regulatory interaction process related to the application for Preliminary and Final Design Approvals and standard design certification is also presented. (author).

12854 (JAERI-M–90-103, pp. 280-299) **Licensing safety issues and results of HTR-module safety concept review by independent experts.** Weisbrodt, I.A. (Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bergisch Gladbach (Germany, F.R.)). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1990. (CONF-900382–: 1. JAERI symposium on high-temperature gas-cooled reactor (HTGR) technologies design, licensing requirements and supporting technologies, Tokyo (Japan), 19-20 Mar 1990). In *Proceedings of the 1st JAERI symposium on HTGR technologies: Design, licensing requirements and supporting technologies*. 431p. Order Number DE91745055. Source: OSTI; NTIS (US Sales Only); INIS.

Humanity is facing great challenges. On the one hand, it is imperative to ward off the impeding menace of an environmental catastrophe, on the other it is necessary to overcome poverty in the third world and to supply the increasing world population, particularly in third countries, with a sufficient amount of energy while at the same time preserving the natural environment. One of the most convincing solutions to the future energy supply is nuclear energy. However, due to the accidents in Three-Mile Island and Chernobyl, public acceptance of nuclear energy has suffered a severe blow. The nuclear industry has taken note of the public concern and started acting accordingly by striving to develop a new generation of nuclear reactors featuring a high degree of passive safety properties. As early as 1979, the development of the modular HTR was launched in the Federal Republic of Germany, taking exacting standards and layout criteria for a basis. The supplying industry soon realized that her own judgement was not sufficient and that the evaluation of the newly developed modular concept by neutral authorities and experts was absolutely indispensable in order to ensure the basis of this development. Thus, the German Board of Experts on Environmental Questions critically reviewed the new modular concept as early as 1981 in a special expertise submitted to the Federal Government and gave a basically positive statement in this matter. Further evaluations of the modular concept were conducted in 1981/82 by a subcommittee of the Reactor Committee, in 1982 by the Rhineland Technical Control Board, and in 1984/85 by a counselling group established by the Federal Minister of the Interior. Encouraged by the positive evaluations, a safety report was developed in the course of 1985 and 1986. In 1987, it was submitted and a review of the safety concept by independent experts was initiated. (author).

12855 (KFK–3701-e) **Triggered fragmentation experiment with sodium, silicone oil and pentane.** Morita, T. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorentwicklung (IRE). Dec 1990. 136p. Translated from German: 'Getriggertes Fragmentationsexperiment mit Natrium, Silikonoel und Pentan', KFK–3701, and dissertation submitted to Karlsruhe Univ., April 1984. Order Number DE91759268. Source: OSTI; NTIS (US Sales Only); INIS.

Within the analysis of severe hypothetical fast breeder accidents the consequences of a fuel-coolant-interaction have to be considered, i.e. the thermal interaction between hot molten fuel and sodium. For the detailed understanding of the fragmentation during the thermal interaction of a hot liquid droplet with a cold fluid series of experiments were performed with sodium and solicone oil as hot liquid and pentane as cold easily volatile fluid. For the precise observation of the reaction an efficient high speed camera with a maximum recording frequency of 1x105 f/s was used. So the fragmentation caused by boiling phenomena could be observed. The pictures were used to estimate quantitatively e.g. the volume of the reaction zone and its expansion rate. By a special measuring device for the first time results on the time dependent portion of the liquid within the reaction zone could be gained. Based on the measured results of the experiments the course of a typical reaction, which can be devided into six phases, is presented and physically explained in this report. The influence of experimental parameters, as pressure of the external trigger and temperature of the hot liquid droplet, was investigated and from this the role of the homogeneous nucleation temperature and the external trigger for the reaction was deduced. (orig.).

12856 (KFK–4358) **Sodium fire investigations in the FAUNA. Pt. 1. Pool fires and aerosol behaviour.** Cherdron, W.; Jordan, S.; Lindner, W. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik (LAF); Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheitsforschung. Nov 1990. 153p. (In German). Order Number DE91759266. Source: OSTI; NTIS (US Sales Only); INIS.

In the research facility FAUNA (Forschungsanlage zur Untersuchung nuklearer Aerosole) the consequences of large scale sodium fires in closed containments had been investigated experimentally for several years. This report describes the pool fire program (with pool surfaces up to 12 m^2) and the properties and behaviour of sodium fire aerosols. Under consideration of the results and the experience of further research facilities the investigations in the FAUNA program show, that in the case of sodium fires the consequences are well known. (orig.).

12857 (LA-UR–91-133) **Low-rise shear wall failure modes.** Farrar, C.R. (Los Alamos National Lab., NM (USA)); Hashimoto, P.S.; Reed, J.W. Los Alamos National Lab., NM (USA). [1991]. 9p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910306–1: International conference on energy in the 90's, Pittsburgh, PA (USA), 11-13 Mar 1991). Order Number DE91007390. Source: OSTI; NTIS; INIS: GPO Dep.

A summary of the data that are available concerning the structural response of low-rise shear walls is presented. This data will be used to address two failure modes associated with the shear wall structures. First, data concerning the seismic capacity of the shear walls with emphasis on excessive deformations that can cause equipment failure are examined. Second, data concerning the dynamic properties of shear walls (stiffness and damping) that are necessary to compute the seismic inputs to attached equipment are summarized. -This case addresses the failure of equipment when the structure remains functional. 23 refs.

12858 (NUREG–1214-Rev.7) **Historical data summary of the systematic assessment of licensee performance: Revision 7.** Allenspach, F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation. Feb 1991. 113p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The Historical Data Summary of the Systematic Assessment of Licensee Performance (SALP) is produced periodically by the US Nuclear Regulatory Commission. This summary provides the results of the assessment for each facility by NRC region and is

further divided into the following sections: Section 1 presents the most recent SALP report ratings for facilities in operation and under construction. Section 2 presents a chronological listing of all SALP report ratings for each operating facility. Section 3 presents a chronological listing of all SALP report ratings for each facility under construction. For historical purposes, past construction ratings for facilities that recently have been licensed also are listed in Section 3.

12859 (NUREG–1275-Vol.6) **Operating experience feedback report - Solenoid-operated valve problems: Commercial power reactors.** Ornstein, H.L. Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data. Feb 1991. 112p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This report highlights significant operating events involving observed or potential common-mode failures of solenoid-operated valves (SOVs) in US plants. These events resulted in degradation or malfunction of multiple trains of safety systems as well as of multiple safety systems. On the basis of the evaluation of these events, the Office for Analysis and Evaluation of Operational Data (AEOD) of the US Nuclear Regulatory Commission (NRC) concludes that the problems with solenoid-operated valves are an important issue that needs additional NRC and industry attention. This report also provides AEOD's recommendations for actions to reduce the occurrence of SOV common-mode failures. 115 refs., 7 figs., 2 tabs.

12860 (NUREG–1397) **An assessment of design control practices and design reconstitution programs in the nuclear power industry.** Imbro, E.V. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards. Feb 1991. 104p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The US Nuclear Regulatory Commission (NRC) and the utilities have identified shortcomings involving the maintenance of well-defined design bases and the availability of the necessary supporting design documentation. Many utilities have embarked on design-document reconstitution programs although there has been no clear consensus regarding what information should be included in design-bases documents, what is the minimum set of necessary design documents to support the design bases, or how missing or deficient design documentation should be handled. The NRC initiated a survey to ascertain the status of design control programs within the industry and the approaches to design-bases documentation used by some utilities. The survey scope included six utilities and one nuclear steam supply system vendor. Conclusions and observations resulting from the survey assessments are provided so that utilities and the NRC can consider actions to improve these programs. 12 refs.

12861 (NUREG/CP–0037) **Proceedings of the seminar on assessment of fracture prediction technology: Piping and pressure vessels.** Hiser, A.L. Jr.; Mayfield, M.E. (eds.). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Feb 1991. 329p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (CONF-900617–Pt.1: 1990 pressure vessels and piping conference, Nashville, TN (USA), 17-21 Jun 1990). Source: OSTI; NTIS; INIS; GPO.

The 1990 Pressure Vessel and Piping Conference, sponsored by the American Society of Mechanical Engineers (ASME), was held in Nashville, Tennessee from June 18 to June 21, 1990. As part of that conference, representatives from the USNRC and AEA Technology in the United Kingdom jointly organized two panel sessions to discuss the current state of fracture prediction technologies for piping and pressure vessels. A total of nine presentations were given, contrasting analytical predictions with experimental results. This document provides summaries of each presentation and copies of the pertinent figures and other visual aids. This information has been compiled and published to permit reasonably prompt dissemination of the information presented. Based on the information presented during these two panel sessions, it appears that, while the current state of fracture prediction technology is reasonably well advanced, more work is needed to provide analysis methods capable of accurately predicting ductile crack extension.

12862 (NUREG/CP–0115) **CSNI workshop on PSA applications and limitations: Proceedings.** Molina, T. (ed.). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 475p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (SAND–90-2797;CONF-9009346–: Committee on the Safety of Nuclear Installations (CSNI) on Probabilistic Safety Assessment (PSA) applications and limitations, Santa Fe, NM (USA), 4-6 Sep 1990). Source: OSTI; NTIS; INIS.

This report contains the full papers submitted to the Committee on the Safety of Nuclear Installations (CSNI) Workshop on Probabilistic Safety Assessment (PSA) Applications and Limitations held in Santa Fe, New Mexico, USA, on September 4 through 6, 1990. The purpose of the Workshop was to provide an avenue for discussions in the following areas: (1) current PSA result, (2) current uses of PSA, (3) views on current limitations, (4) expert opinion, and (5) low probability numbers. The papers contained herein address these issues, along with several other related topics.

12863 (NUREG/CR–4911) **Incentive regulation of nuclear power plants by state regulators.** Martin, R.L. (Battelle Human Affairs Research Center, Seattle, WA (USA)); Baker, K.; Olson, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; Pacific Northwest Lab., Richland, WA (USA); Battelle Human Affairs Research Center, Seattle, WA (USA). Feb 1991. 89p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC06-76RL01830. (PNL–7596;BHARC–700/90/033). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) monitors incentive programs established by state regulators in order to obtain current information and to consider the potential safety effects of the incentive programs as applied to nuclear units. The current report is an update of NUREG/CR-5509, Incentive Regulation of Nuclear Power Plants by State Public Utility Commissions, published in December 1989. The information in this report was obtained from interviews conducted with each state regulator and each utility with a minimum entitlement of 10%. The agreements, orders, and settlements from which each incentive program was implemented were reviewed as required. The interviews and supporting documentation form the basis for the individual state reports describing the structure and financial impact of each incentive program. The programs currently in effect represent the adoption of an existing nuclear performance incentive program proposal and one new program. In addition, since 1989 a number of nuclear units have been included in one existing program; while one program was discontinued and another one concluded. 6 refs., 27 tabs.

12864 (NUREG/CR–5288) **Closeout of IE Bulletin 80-06: engineered safety feature (ESF) reset controls.** Foley, W.J. (Parameter, Inc., Elm Grove, WI (USA)); Dean, R.S.; Kloehn, B.A.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment; Parameter, Inc., Elm Grove, WI (USA). Feb 1991. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PARAMETER/IE–164). Source: OSTI; NTIS; INIS; GPO.

Documentation is provided in this report for the closeout of IE Bulletin 80-06 regarding the change of safety-related equipment from the emergency or safety mode upon reset of the ESF signal. Closeout is based on the implementation and verification of four (4) required actions. Evaluation of utility responses and NRC/Region inspection reports, in accordance with two criteria, indicates that the bulletin is closed for 61 (95%) of the 64 operating nuclear power facilities to which it was issued for action. Follow-up items are proposed for the three facilities with open status, Browns Ferry 1, 3, and Millstone 1. Facilities which were shut down indefinitely or permanently at the time of issuance of this report are not included in this review. Background information is presented in the introduction and Appendix A. The conclusion is made that the bulletin concerns have been resolved pending closeout of Browns Ferry 1, 3, and Millstone 1.

12865 (NUREG/CR–5665) **A systematic approach to repetitive failures.** Odland, D.J. (Sonalysts, Inc., Waterford, CT (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Sonalysts, Inc., Waterford, CT (USA). Feb

1991. 31p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (SI–14940000-1). Source: OSTI: NTIS; INIS; GPO.

This report presents a model of a systematic approach to address and correct repetitive failures. In this context, repetitive failures are the recurring inability of a system, subsystem, structure, or component to perform its intended function. The report presents a systematic method for identifying repetitive failures, selecting the failures to be investigated, determining root cause, selecting corrective actions for implementation, and monitoring of subsequent system/component performance. Appendix A provides an example of the use of this methodology at an operating nuclear generating station. 4 figs.

12866 (NUREG/CR–5667) **INEL personal computer version of MACCS 1.5.** Jones, K.R. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Dobbe, C.A.; Knudson, D.L. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1991. 26p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC07-76ID01570. (EGG–2634). Source: OSTI; NTIS; INIS; GPO.

The MELCOR Accident Consequence Code System, Version 1.5, (MACCS 1.5) calculates potential consequences resulting from atmospheric releases of radioactive materials. Sandia National Laboratories developed the code for the US Nuclear Regulatory Commission on a VAX/VMS mini-computer. This report documents the Idaho National Engineering Laboratory conversion of MACCS 1.5 for compilation and execution on an 80386-based IBM or IBM-compatible personal computer (PC). The resulting PC version of the code is available through the National Energy Software Center, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439. 2 refs., 1 fig., 1 tab.

12867 (ORNL/FTR–3864) **[Centralized reliability data organization for liquid metal reactor components]: Foreign trip report, 20 January 1991–25 January 1991.** Smith, M.S.; Manneschmidt, J.F. Oak Ridge National Lab., TN (USA). 7 Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91007816. Source: OSTI; NTIS; GPO Dep.

The Centralized Reliability Data Organization is a data bank and data analysis center, focusing on reliability, availability, and maintainability (RAM) data for components (e.g., valves, pumps, etc.) operating in liquid metal reactors and test facilities. PNC staff are using the CREDO data base as a resource for their development of a probabilistic safety assessment (PSA) for the MONJU fast breeder reactor now under construction. The meeting was held to discuss: (a) progress in FY 1989, (b) resolution of data base deficiencies and inconsistencies, (c) clarification of definitions for failure mode and failure cause, (d) component boundary definitions, (e) goals and objectives for the remainder of the fiscal year, and (f) proposals for future work. General agreement was reached on the need for improvements to the data base: resolution of data deficiencies and inconsistencies, reduction of the number of failure modes and causes, inclusion of failure severity, and a specific delineation of the boundary for each of the generic components. A schedule will be provided to PNC by 1 March 1991 addressing these issues. A proposal to develop a hybrid mainframe/PC reliability data base to improve user access was declined. A second proposal to develop a reliability data base for PNC's nuclear fuel reprocessing facilities was met with a request for more information. A formal proposal will be forwarded to PNC in the near future.

12868 (PSI–87) **Sensitivity analysis using DECOMP and METOXA subroutines of the MAAP code in modelling core concrete interaction phenomena and post test calculations for ACE-MCCI experiment L-5.** Passalacqua, R.A. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1991. 78p. Order Number DE91623400. Source: OSTI; NTIS (US Sales Only); INIS.

A parametric analysis approach was chosen in order to study core-concrete interaction phenomena. The analysis was performed using a stand-alone version of the MAAP-DECOMP model (DOE version). This analysis covered only those parameters known to have the largest effect on thermohydraulics and fission product aerosol release. Even though the main purpose of the effort was model validation, it eventually resulted in a better understanding of the core-concrete interaction physics and to a more correct interpretation of the ACE-MCCI L5 experimental data. Unusual low heat transfer fluxes from the debris pool to the cavity (corium surrounding volume) were modeled in order to have a good benchmark with the experimental data. Therefore, higher debris pool temperatures were predicted. In case of water flooding, as a consequence of the critical heat flux through the upper crust and the increase of the crust thickness, resulting high debris pool temperatures cause an increase in the concrete ablation rate in the short term. DECOMP model predicts a quick increase of the crust thickness and as a result, causes the quenching of the molten mass. However, especially for fast transient, phenomena of crust bridge formation can occur. Thus, the upward directed heat flux is minimized and the concrete erosion rate remains conspicuous also in the long term. The model validation is based, in these calculations, on post-test predictions using the MCCI L5 test data: these data are derived from results of the 'Molten Core Concrete Interaction' (MCCI) experiments, which in turn are part of the larger Advanced Containment Experiment (ACE) program. Other calculations were also performed for the new proposed MACE (Melt Debris Attack and Coolability) experiments simulating the water flooding of the cavity. Those calculations are preliminarily compared with the recent MACE scoping test results. (author) 4 tabs., 59 figs., 5 refs.

12869 (WSRC-MS–90-12) **A parametric model for fission product release from molten pools of U-Al mixtures.** Ellison, P.G. (Westinghouse Savannah River Co., Aiken, SC (USA)); McClure, P.R.; Leonard, M.T. Westinghouse Savannah River Co., Aiken, SC (USA). 29 May 1990. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-900917–34: American Nuclear Society (ANS) topical meeting on safety of commercial nuclear reactor research and irradiation facilities, Boise, ID (USA), 30 Sep - 3 oct 1990). Order Number DE91007927. Source: OSTI; NTIS; INIS; GPO Dep.

A computational model for fission product release from molten pools of U-Al alloy is described. The model considers several processes governing the release of fission products from this system including pool heat transfer and fluid mechanics, bubble dynamics for fission product vapors, and diffusion. The model is intentionally parametric in structure providing substantial flexibility to examine the effects of alternative modeling assumptions. Results from selected sensitivity calculations are presented to illustrate predicted results. 21 refs., 6 figs.

12870 (WSRC-MS–90-15) **Fission product release phenomena during core melt accidents in metal fueled heavy water reactors.** Ellison, P.G. (Westinghouse Savannah River Co., Aiken, SC (USA)); Hyder, M.L.; Monson, P.R.; Randolph, H.W.; Hagrman, D.L.; McClure, P.R.; Leonard, M.T. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-900917–35: American Nuclear Society (ANS) topical meeting on safety of commercial nuclear reactor research and irradiation facilities, Boise, ID (USA), 30 Sep - 3 oct 1990). Order Number DE91007966. Source: OSTI; NTIS; INIS; GPO Dep.

The phenomena that determine fission product release rates from a core melting accident in a metal-fueled, heavy water reactor are described in this paper. This information is obtained from the analysis of the current metal fuel experimental data base and from the results of analytical calculations. Experimental programs in place at the Savannah River Site are described that will provide information to resolve uncertainties in the data base. The results of the experiments will be incorporated into new severe accident computer codes recently developed for this reactor design. 47 refs., 4 figs.

12871 (WSRC-RP–89-1390) **Flow excursion experiments with a production reactor assembly mockup.** Rush, G.C. (Babcock and Wilcox Co., Alliance, OH (USA)); Blake, J.E.; Nash, C.A. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-900917–36: American Nuclear Society (ANS) topical meeting on safety of commercial nuclear reactor research and irradiation facilities, Boise, ID (USA), 30 Sep - 3 oct

1990). Order Number DE91007959. Source: OSTI; NTIS; INIS; GPO Dep.

A series of power ramp and loss-of-coolant accidents were simulated with an electrically heated mockup of a Savannah River Site production reactor assembly. The one-to-one scale mockup had full multichannel annular geometry in its heated section in addition to prototypical inlet and outlet endfitting hardware. Power levels causing void generation and flow instability in the water coolant flowing through the mockup were found under different transient and quasi-steady state test conditions. A reasonably sharp boundary between initial operating powers leading to or not leading to flow instability were found: that being 0.2 MW or less on power levels of 4 to 6.3 MW. Void generation occurred before, but close to, the point of flow instability. The data were taken in support of the Savannah River reactor limits program and will be used in continuing code benchmarking efforts. 6 refs., 12 figs., 2 tabs.

25 ENERGY STORAGE

12872 (LBL-PUB-679) **Lawrence Berkeley Laboratory catalog of research projects.** Lawrence Berkeley Lab., CA (USA). Jan 1991. 185p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009075. Source: OSTI; NTIS; GPO Dep.

Research from Lawrence Berkeley Laboratory is briefly presented. Topics include: (1) Applied Science; (2) Chemical Sciences; (3) Earth Sciences; (4) Materials Sciences; (5) Accelerator and Fusion Research; (6) Nuclear Science; (7) Physics; (8) Cell and Molecular Biology; (9) Chemical Biodynamics; (10) Research Medicine and Radiation Biophysics; (11) Engineering; (12) Environmental Protection, Health and Safety; and (13) Information and Computing Sciences. (WET)

2506 Thermal

Refer also to citation(s) 12613

12873 (BFR-R-92-90) **Heat storage in clay with sand drainage.** Adolfsson, K. (Chalmers Univ. of Tech., Goeteborg (SE). Geotechnical Engineering); Saellfors, G. Swedish Council for Building Research, Stockholm (Sweden). 1990. 59p. (In Swedish). Project BFR-840256-2. Order Number DE91753074. Source: OSTI; NTIS (US Sales Only).

Storage of heat in clay layers is in many cases feasible and economical. A drawback with a heat storage facility in clay is that it is slow, e.g. the temperature gradients quickly become large, and thereby also the difference in temperature between the brine and the average clay temperature. The thermal properties of the storage can be greatly improved by the use of so called 'heat drains'. Thereby a short term storage is obtained, the drain itself acts as a heatbuffer during peaks of loading as well as unloading. The heat drain can also reduce the pore pressures which usually develop due to the increase in temperature of the clay. The project described in this report include a laboratory study as well as full scale test with seven heat drains in the field. In the laboratory the effect of the grain size distribution on the distribution of temperatures within the drain was investigated. Three different grain size distributions were tested all together. In another test fine cobbles were used and substantial convection was obtained. The analysis of the field test, where a courser material (4-12 mm) was used indicated an almost total convection. During field tests, temperatures and pore pressures were measured at a number of points. The measurement showed that the pore pressures were only 30-40% of those obtained in a similar test where conventional heat exchanges were used. Thereby the settlements due to the heating of the clay could be expected to develop during a much shorter period of time, than for conventional exchangers.

2509 Batteries

Refer also to citation(s) 13062

12874 (ENET-8900420-1) **Final report: feasibility of a battery with bipolar cells by tape-casting: Phase 1: adjustment of the shrinking of a dense zirconia layer and a porous manganite layer.** Issartel, J.P. (Battelle Memorial Inst., Geneva (Switzerland)); Sandoz, N. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Sep 1989. vp. (In French). Order Number DE91749217. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

A definition was given of a technology for producing dense electrolytic layers from $ZrO_2.8Y_2O_3$ and porous electrodes from $(La_{0.86}.Sr_{0.14})MnO_3$. These materials were developed to display a similar rate of shrinkage of 1.5% maximum during sintering so as to enable them to be jointly sintered in a subsequent phase. The size of the sintered layers lies in the magnitude of 44x44 mm. Thicknesses are approximately 100 microns for the zirconium oxide and 500 microns for the manganite. Measurements were taken of the gas flow along the manganite layer. The density of the zirconium oxide layer was subjected to an ink test. At the current stage of the project it appears that the zirconium oxide microstructure best adapted to the manganite layer displays a slight degree of porosity, which is not incompatible with the planned application. A denser zirconium oxide layer can be used if it proves possible to adapt its shrinkage better to the shrinkage of the current layer of manganite. If necessary, this solution can be investigated in a second phase.

12875 (EUR-12708) **Solid-state lithium advanced battery project: Final summary report.** Hooper, A. (ed.) (UKAEA Harwell Lab. (UK). Materials Engineering Centre). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; UKAEA Harwell Lab. (UK). Materials Engineering Centre. 1990. 12p. Sponsored by Com. EN3E/0061/UK. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The overall objective of this programme was the demonstration of the scale-up of a polymer electrolyte-based rechargeable lithium battery technology. The primary application goal is electric vehicle traction. Herriot-Watt University, Edinburgh, was subcontracted to carry out interfacial studies of battery components and some of the materials studied at Harwell were supplied by the University of Rome. Matching financial support was provided by a UK industrial company. The programme has concentrated on an elevated temperature system (100–140°C). This was demonstrated at the laboratory scale during a previous CEC-funded project and employs standard poly(ethylene oxide) electrolytes.

12876 (LBL-30132) **Experimental and theoretical investigation of a zinc model pore with probe beam deflection.** Weaver, J.K.; McLarnon, F.R.; Cairns, E.J. Lawrence Berkeley Lab., CA (USA). Dec 1990. 128p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009093. Source: OSTI; NTIS; GPO Dep.

Thesis submitted by J.K. Weaver.

Optical probe beam deflection has been employed to study two-dimensional concentration gradients within the electrolyte of a zinc model pore. The model pore cell constructed for this study retains the small, confined geometry and two-dimensional character of an actual pore within a porous zinc electrode. The concentration and concentration gradients of the electrolyte species were calculated by a numerical model and were used to interpret the experimental measurements obtained using the probe beam deflection technique. Good quantitative agreement between experiment and theory was obtained. The combination of theoretical and experimental analyses led to an understanding of how the kinetic, geometric, and mass transport parameters determined the current and concentration distributions within the model pore electrolyte. 50 refs., 18 figs., 2 tabs.

12877 (NEI-DK-487) **New battery types with non-aqueous inorganic electrolytes: Final report.** Hjuler, H.Aa.; Knutz, B.C.; Berg, R.W., Bjerrum, N.J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Kemisk Lab. A. Jun 1990 162p. (In Danish). Contract EM-1443/87-2. Order Number DE91752948. Source: OSTI; NTIS (US Sales Only).

EFP-87.

A resume of the project undertaken where periodical articles and papers etc. which have been produced in relation to the main project are also included as supplements. In the cases of the

battery types described the electrolytes have contained molten aluminium chlorides. The emphasis was on the development of medium temperature batteries. Here aluminium was used for anodes and transition metal sulfides as cathodes. As electrolytes, $NaCl-AlCl_3$ at a temperature of 175 degrees centigrade and newly developed alkali aluminate electrolytes were used at a temperature of 100 degrees centigrade. The room temperature batteries were based on electrolytes of $SOCl_2$, SO_2Cl_2 or $POCl_3$. More generally, the work included the construction and testing of experimental batteries. In addition anode morphology, the reaction mechanism of cathodes and the characteristics of electrolytes have been examined. (AB) 33 refs.

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 12795

2901 Energy Analysis and Modeling

Refer also to citation(s) 12909

12878 (LUTMDN-TMVK–1007-1-139-90) **Physical planning with regard to energy.** Lamm, J.O. Lund Inst. of Tech. (Sweden). Div. of Heat and Power Engineering. 30 Jul 1990. 140p. (In Swedish). Order Number DE91753031. Source: OSTI; NTIS (US Sales Only).

This study deals with the relation between urban form and energy. The aim is to develop a method for the allocation of urban elements with regard to energy aspects. The aspects considered are local climate, energy supply system and systems for transportation of people, material and media. The study considers the allocation of a single urban element - in this case a dwelling. Factors that might have an influence upon the use of energy when operating an urban element are analysed. A criterion on energy for allocation is stated. For the purpose of allocation the area under consideration for planning (a municipality) is divided into subareas. For these areas the impact on energy turnover of local climate, energy supply system and transportation system is specified. Using a computer simulation it is possible to calculate the potential energy turnover for an urban element located within each subarea. Areas with an energy turnover in accord with the stated criterion on energy turnover are delimited. Housing located to these areas will fulfil the criterion in energy considering all major aspects of energy relevant to urban form. The interaction between different factors that have an influence upon the allocation are discusssed. The method for solving this problem is to make a specific allocation study for possible variation in each factor. When the results of these simulations are studied together certain allocations are common to all simulations. Housing located to these areas will thus be resistant to interaction between factors. The possibility for taking the financial and environmental aspects into the process is discussed. It is demonstrated that the method is possible to extend to consider these aspects. (author).

2902 Economics and Sociology

Refer also to citation(s) 12465, 12882, 12908

12879 (CONF-9104197–1) **Improving risk communication through interactive training in communication skills.** White, D.A.; White, R.K. Oak Ridge National Lab., TN (USA). [1991]. 17p. Sponsored by USDOE. Washington, DC (USA). DOE Contract AC05-84OR21400. From Hazardous Materials Control Research Institute (HMCRI) superfund southeast conference: Houston, TX (USA): 24-26 Apr 1991. Order Number DE91009155. Source: OSTI: NTIS: GPO Dep.

This paper describes a workshop in communication and public speaking skills recently conducted for a group of public officials whose responsibilities include presenting risk information at public meetings associated with hazardous waste sites. We detail the development and execution of the 2 and 1/2 day workshop. including the development and integration of a 45-minute video of a simulated public meeting used to illustrate examples of good and bad communication behaviors. The workshop uses a mock public meeting video, participatory video exercises, role-playing, an instructor, and a resource text. This interactive approach to teaching communication skills can help sensitize scientists to the public's understanding of risk and improve scientists' confidence and effectiveness in communicating scientific information. 11 refs., 1 fig.

2903 Environment, Health, and Safety

Refer also to citation(s) 12465, 12527, 12535, 12879, 12898, 13419, 13423, 13488, 13501, 13515, 13931

12880 (CONF-910290–1) **The regulations for radionuclides and chemicals in the environment.** Kocher, D.C. Oak Ridge National Lab., TN (USA). [1991]. 111p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From Pathway analysis and risk assessment for environmental compliance and dose reconstruction conference; Kiawah Island, SC (USA); 25 Feb - 1 mar 1991. Order Number DE91008379. Source: OSTI; NTIS; GPO Dep.

This paper presents information on the regulations for radionuclides and chemicals in the environment. Included are detailed information on current and proposed standards, recommendations, guidances for limiting routine and accidental radiation exposures of the public, and a review of certain laws and regulations intended primarily for limiting exposures of the public to non-radioactive hazardous materials. Limits on risk to the public embodied in laws and regulations are emphasized. Risk is only basis for comparing potential impacts from exposure to radionuclides and other hazardous materials.

12881 (CONF-910477–1) **SARA Title III and community hazards planning: Lessons for the US Army's Chemical Stockpile Emergency Preparedness Program.** Feldman, D.L. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. From 4. annual hazardous materials management central conference and exhibition; Rosemont, IL (USA); 3-5 Apr 1991. Order Number DE91009123. Source: OSTI; NTIS; GPO Dep.

This paper provides an overview and analysis of the impact of Title 3 of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title 3) on improving community participation and risk communication and facilitating decisions leading to enhanced emergency preparedness for timely response to accidental hazardous chemical releases. The US Army's Chemical Stockpile Disposal Program (CSDP) and attendant Chemical Stockpile Emergency Preparedness Program (CSEPP) are case studies. In addition to reviewing progress in SARA Title 3 implementation in the 10 states directly affected by these programs, interviews were conducted with regional Environmental Protection Agency (EPA) and Federal Emergency Management Agency (FEMA) representatives responsible for overseeing staffing and fiscal decisions that enable this law to take effect. These interviews also permit derivation of a broad federal perspective on Title 3's success (or lack thereof) in heightening public awareness of chemical hazards and improving local political competence in addressing chemical hazards warning, notification, communication, and procurement and equipment acquisition issues. We conclude that SARA Title 3 has significantly transformed the process of chemical and other technological hazards management by forcing greater cooperation between federal agencies (particularly EPA, FEMA, and, in some instances, the Occupational Health and Safety Administration, or OSHA) and states in planning and conducting emergency exercises. The process of emergency planning is becoming increasingly decentralized. However, we also conclude that Local Emergency Planning Committees (LEPCs) and State Emergency Response Commissions (SERCs)–institutions established under Title 3–are faced with several challenges in order to ensure viable risk communication and achievement of enhanced preparedness in local communities nationwide. 36 refs., 3 tabs.

12882 (ETDE-mf–1755026) **The Internal Market and environmental policy in the Federal Republic of Germany and the Netherlands.** Bennett, G.; Weizsaecker, E.U. von; Baldock, D.; Lavoux, T.; Hannequart, J.P.; Maier-Rigaud, G.; Vonkeman, G. Institut fuer Europaeische Umweltpolitik e.V. (IEUP), Bonn (Germany,

F.R.); Umweltbundesamt, Berlin (Germany, F.R.). Nov 1989 124p. Contract UFOPLAN 10101071. Order Number DE91755026. Source: OSTI; NTIS (US Sales Only).

The study presents an outline of the legal frame set for the Internal Market and its implications for national environmental policies. National perspectives from Germany, Netherlands, France and Britain to the completion of the Internal Market are given, both in terms of economic and environmental policy. Four key environmental policy areas are studied in particular: Products, waste management, transportation and energy (common carrier concept for electricity distribution). Relating to these four policy fields, the report finally assesses the specific impacts on environmental policies in the FRG and the Netherlands of the completion of the Internal Market. In summary the completion of the Internal Market does not seem to prevent environmently progressive countries from taking the nesessary action. It seems advisable, however, to first exploit the new opportunities given in the Treaty (articles 100 a, 130 s); and to focus on instruments which cannot reasonably be considered trade barriers; especially economic instruments of environmental policy seem to be suggestive tools in this regard. (orig./HSCH) With 112 refs., 17 tabs.

12883 (Juel–2390) **A convention on greenhouse gases: Towards the design of a verification system.** Fischer, W.; Di Primio, J.C.; Stein, G. Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Technologiefolgenforschung. Oct 1990. 51p. Order Number DE91759457. Source: OSTI; NTIS (US Sales Only).

The core elements of the verification system are as follows: Calculation and declaration of energy consumption and the associated CO_2 emissions by the national authorities and verification of these declaration by the international authority by means of audit and other methods verifying the plausibility and reliability of the data. Use of space-based (and other) global remote sensing systems to monitor forests, deforestation and, if possible, infrastructural and land-use activities by member states in order to verify agreed commitments concerning forest protection, reforestation etc. Studies, audits and procedural verification in the sectors where emissions cannot be either precisely calculated or monitored by means of remote sensing (parts of the energy sectors, agriculture, waste disposal sites). (orig.).

12884 (PNL-SA–19148) **Introducing new technologies into today's cleanup arena.** Gephart, K.E.; Keller, J.F.; Stein, S.L. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 13p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910270–16: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008260. Source: OSTI; NTIS; INIS; GPO Dep.

The introduction of new technologies into the environmental cleanup arena has proven to be time-consuming, expensive, and encumbered by many institutional, regulatory, and technical obstacles. Therefore, cleanup contractors and regulators have tended to rely on established, historically proven technologies even though more effective approaches are needed. This paper addresses some of the key issues facing industry and the federal agencies in their attempts to use new technologies to meet expanding environmental management needs. 13 refs.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 12282, 12626, 12629, 12654, 12893, 12908, 12910

12885 (ENEA-RT-INN–90-13) **Reference materials: assessment of present situation.** Biancifiori, M.A.; Madaro, M. ENEA, Casaccia (Italy). Centro Ricerche Energia. Sep 1990. 61p. (RT/INN–90-13). Order Number DE91752919. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements and analyses are becoming more and more important, especially with the introduction of automation in production systems: this implies increased attention to the accuracy and quality of measurements. In analytical chemistry, in particular, reference materials play a fundamental role, because they are one of the main means to verify the results and, consequently, to guarantee measurement reliability. In this work, the role of reference materials within an accurate and compatible measurement system is described, while the currently used terminology is examined together with the definitions proposed by international organizations. The different certification modes used by the organizations active in the field are described, as well as some general problems such as stability and homogeneity. The statistical tests often used for rejecting outliers and for deriving certified values and their uncertainties are briefly described, together with some criteria for the evaluation of the quality of results obtained in certification campaigns or interlaboratory comparisons. Finally, the initiatives existing both at the international and national levels are reviewed. Attention is given to the more experienced institutions such as IAEA, NBS and BCR.

12886 (NEI-DK–482) **Plumbing and energy: The Single Market's specifications for technology.** Clausen, I.-L.; Bryder, K.L. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. May 1990 162p. (In Danish). Order Number DE91752941. Source: OSTI; NTIS (US Sales Only).

The Commission for the European Communities gives directives founded on concrete requirements expressed in basic documents, produced by committees of specialists, on standards regarding the technological niveau of imported goods within the Single Market. The structure of the European standardization organizations dealing with directives concerning building materials, plumbing and energy-technological installations, and these organizations' relation to the Danish ones, is described. The organizations shall cooperate with the European testing and certifying organization to ensure the working-out of marking and certification procedures. A list of sources of further information and of the relevant organizations is included.(AB).

12887 (NEI-DK–484) **Initiating new offices for energy.** Samvirkende Energikontorer i Danmark (Denmark). 1990 39p. (In Danish). Contract TR-89.0283. Order Number DE91752945. Source: OSTI; NTIS (US Sales Only).

It is claimed that in order to live up to the principles of the Danish "Energy plan 2000", especially with regard to the development of the use of renewable energies, it is advisable to initiate "energy offices" as centres for information dissemination amongst members of the public. These offices receive government support. The activities of the various already established centres are briefly described in addition to their forms of cooperation with other Danish organizations. Activities and results from three newly established centres in Viborg, South Fynen and Thy are described in more detail. The centres instigate tours of renewable energy plants, informative meetings, courses and consultant services. (AB).

12888 (PNL–7329) **Technology modernization assessment flexible automation.** Bennett, D.W.; Boyd, D.R.; Hansen, N.H.; Hansen, M.A.; Yount, J.A. Pacific Northwest Lab., Richland, WA (USA). Dec 1990. 75p. Sponsored by U.S. DOE Contract AC06-76RL01830. Order Number DE91005620. Source: OSTI; NTIS; GPO Dep.

The objectives of this report are: to present technology assessment guidelines to be considered in conjunction with defense regulations before an automation project is developed to give examples showing how assessment guidelines may be applied to a current project to present several potential areas where automation might be applied successfully in the depot system. Depots perform primarily repair and remanufacturing operations, with limited small batch manufacturing runs. While certain activities (such as Management Information Systems and warehousing) are directly applicable to either environment, the majority of applications will require combining existing and emerging technologies in different ways, with the special needs of depot remanufacturing environment. Industry generally enjoys the ability to make revisions to its product lines seasonally, followed by batch runs of thousands or more. Depot batch runs are in the tens, at best the hundreds, of parts with a potential for large variation in product mix; reconfiguration may be required on a week-to-week basis. This need for a higher degree of flexibility suggests a higher level of operator interaction, and, in turn, control systems that go beyond the state of the art for less flexible automation and industry in general. This report investigates the benefits and barriers to automation and concludes

that, while significant benefits do exist for automation, depots must be prepared to carefully investigate the technical feasibility of each opportunity and the life-cycle costs associated with implementation. Implementation is suggested in two ways: (1) develop an implementation plan for automation technologies based on results of small demonstration automation projects; (2) use phased implementation for both these and later stage automation projects to allow major technical and administrative risk issues to be addressed. 10 refs., 2 figs., 2 tabs. (JF)

2906 Nuclear Energy

Refer also to citation(s) 12466, 12791, 12792, 13580

12889 (INIS-mf-12176) **KTA annual report 1989.** Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.). 1990 36p. (In German). Order Number DE91756443. Source: OSTI; NTIS (US Sales Only); INIS.

Whenever the experts of manufacturers, builders, and operators of nuclear facilities, of consultants and authorities are close to coming to a uniform opinion, the KTA has to see to it that safety codes in the field of nuclear engineering are drawn up and that their application is promoted. The publication reports on standardization work and other activities, and presents data on administration and the budget. (orig./UA).

12890 (Juel-2357) **Critical comments concerning the amended Radiation Protection Ordinance (StrlSchV).** Heinzelmann, M. Forschungszentrum Juelich GmbH (Germany, F.R.). Abt. Sicherheit und Strahlenschutz. May 1990. 19p. (In German). Order Number DE91759221. Source: OSTI; NTIS (US Sales Only); INIS.

The contribution criticizes several items in the annex of the StrlSchV, whereby the criticism in some cases is more serious than in others. Important are those points which deal with the safety of employees, and those which facilitate monitoring. In order to increase safety, MAC values should be pointed out in the case of long-lived radionuclides, and the limiting value of activity concentration for gaseous tritium in air should be restipulated taking into account the autooxidation rate and the measuring possibilities for detecting tritiated vapor in the presence of gaseous tritium. Proposals are made for enhancing and facilitating radiation protection monitoring. (orig./HSCH).

12891 (MLM-3677) **Measurement control administration for nuclear materials accountability.** Rudy, C.R. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 31 Jan 1991. 17p. Sponsored by USDOE,. DOE Contract AC04-88DP43495. Order Number DE91007664. Source: OSTI; NTIS; INIS; GPO Dep.

In 1986 a measurement control program was instituted at Mound to ensure that measurement performance used for nuclear material accountability was properly monitored and documented. The organization and management of various aspects of the program are discussed. Accurate measurements are the basis of nuclear material accountability. The validity of the accountability values depends on the measurement results that are used to determine inventories, receipts, and shipments. With this measurement information, material balances are calculated to determine losses and gains of materials during a specific time period. Calculation of Inventory Differences (ID) are based on chemical or physical measurements of many items. The validity of each term is dependent on the component measurements. Thus, in Figure 1, the measured element weight of 17 g is dependent on the performance of the particular measurement system that was used. In this case, the measurement is performed using a passive gamma ray method with a calibration curve determined by measuring representative standards containing a range of special nuclear materials (Figure 2). One objective of a measurement control program is to monitor and verify the validity of the calibration curve (Figure 3). In 1986 Mound's Nuclear Materials Accountability (NMA) group instituted a formal measurement control program to ensure the validity of the numbers that comprise this equation and provide a measure of how well bulk materials can be controlled. Most measurements used for accountability are production measurements with their own quality assurance programs. In many cases a measurement control system is planned and maintained by the developers and operators of the particular measurement system with oversight by the management responsible for the results. 4 refs., 7 figs.

12892 (NUREG-0386-Digest5-Rev.9) **United States Nuclear Regulatory Commission staff practice and procedure digest: Commission, Appeal Board Licensing Board decisions, July 1972-September 1990: Revision 9.** Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel. Feb 1991. 568p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This Revision 9 of the fifth edition of the NRC Staff Practice and Procedure Digest contains a digest of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period from July 1, 1972 to September 30, 1990 interpreting the NRC's Rules of Practice in 10 CFR Part 2. This Revision 9 replaces in part earlier editions and revisions and includes appropriate changes reflecting the amendments to the Rules of Practice effective through September 30, 1990. This edition of the Digest was prepared by attorneys from Aspen Systems Corporation pursuant to Contract number 18-89-346. Persons using this Digest are placed on notice that it may not be used as an authoritative citation in support of any position before the Commission or any of its adjudicatory tribunals. Persons using this Digest are also placed on notice that it is intended for use only as an initial research tool, that it may, and likely does, contain errors, including errors in analysis and interpretation of decisions, and that the user should not rely on the Digest analyses and interpretations but must read, analyze and rely on the user's own analysis of the actual Commission, Appeal Board and Licensing Board decisions cited. Further, neither the United States, the Nuclear Regulatory Commission, Aspen Systems Corporation, nor any of their employees makes any expressed or implied warranty or assumes liability or responsibility for the accuracy, completeness or usefulness of any material presented in the Digest. The Digest is roughly structured in accordance with the chronological sequence of the nuclear facility licensing process as set forth in Appendix A to 10 CFR Part 2. Those decisions which did not fit into that structure are dealt with in a section on general matters. Where appropriate, particular decisions are indexed under more than one heading. (JF)

12893 (UCRL-ID-106454-90-4) **Lawrence Livermore National Laboratory Safeguards and Security quarterly progress report to the Department of Energy Office of Safeguards and Security: Quarter ending December 31, 1990.** Ruhter, W.D.; Al-Ayat, R.; Cole, C.E.; Thomas, L.L. Lawrence Livermore National Lab., CA (USA). Jan 1991. 29p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91007637. Source: OSTI; NTIS; INIS; GPO Dep.

The Safeguards Technology Program (STP) at Livermore supports the Technology Development Program of the Office of Safeguards and Security (OSS) in three subprogram areas (tasks): 1. Science and Technology Base Development Intelligent Actinide Analysis System Deterioration of Pu Isotopic Analysis with Neutron Damage to HPGe Detectors 2. Onsite Test and Evaluation and Facility Support Isotopic Analysis of Plutonium Samples Enriched in ^{238}Pu Actinide Isotopic Analysis System for Los Alamos Plutonium-Handling Facility 3. International Safeguards MGA Workshop Transportable X-Ray Fluorescence Analysis System. The report describes the activities in Safeguards Technology and Systems studies, computer security and Advanced Laser Isotope Systems safeguards. 3 refs., 3 figs. (JF)

2908 Heat Utilization

Refer also to citation(s) 12949, 13003

12894 (ENET-8900013/1) **RABTHERM - Preliminary study on the utilization of heat from the raw sewage of the city of Zuerich.** Glauser, H. (METRON AG, Zuerich (CH)); Ziegler, K.; Mueller, E.A.; Studer, U.; Witmer, A. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Nov 1988. 107p. (In German). Order Number DE91749224. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

On the basis of the present study, it is possible to recommend the utilization of heat from the raw sewage of the city of Zuerich. The temperature of the raw sewage has an important bearing on the treatment operations of the Werdhoelzli sewage treatment plant. However, the fact that the treatment plant is designed for a minimum temperature of 10 C makes it possible to treat sewage efficiently even under extreme winter conditions. By virtue of this design temperature and current operating conditions, it is possible to utilize the heat of the raw sewage down to a cooling limit of 11 C in the inlet duct of the sewage treatment plant. The available heat potential is considerable and will tend to increase in the future. What is interesting as far as heat utilization is concerned, apart from the relatively high temperature, is also the decentralized output throughout the municipal area. When new sewers are being built potential users of heat should be encouraged to plan heat utilization plants. The available temperature and, to a certain extent, quantity data for the Werdhoelzli sewage treatment plant, from March '87 to '88, formed the principal basis for this study. Continuous measurements over the next few years are an important prerequisite of further studies, as well as of the planning and dimensioning of such heat utilization plants. Practical experience gained by building and running pilot plants are a further important prerequisite for more precise knowledge of the influencing factors and interactions. For this reason pilot projects, such as those in Hoengg in municipal buildings or in private properties are to be financially assisted by the city. figs., tabs., 31 refs.

12895 (STF–11A90013) **Heat pumps for district heating applications.** Lorentzen, G. Divisjon Kulde NTH-SINTEF, Trondheim (Norway). Mar 1990. 15p. Order Number DE91753002. Source: OSTI; NTIS (US Sales Only).

While the cogeneration and heat pump cycles are theoretically equivalent in a thermodynamic sense, they have greatly different characteristics in their performance of practical application. The former must be quite large in order to be cost effective and requires a very extensive and costly heat distribution system. The latter can be built economically in much smaller size and can profit by using low temperature heating systems. The design of a district heating scheme using heat pumps must therefore differ fundamentally from the traditional ones, based on combustion or exhaust heat at relatively high temperature. Modern development in housing technology makes for much reduced heat demand and a corresponding increased need for summer cooling. This is an ideal situation for the heat pump. The system is also capable of important technical improvement. There is little doubt that a new generation of heat pumps will emerge to cover a much wider field of heating at moderate temperature in the years to come. 8 refs., 14 figs.

2910 Conservation

Refer also to citation(s) 12938

12896 (DOE/CE–0281P-3) **Federal energy management activities: FEMP update, Summer/Fall 1990.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Federal Energy Management Program. [1990]. 28p. Sponsored by USDOE,. Order Number DE91008200. Source: OSTI; NTIS; GPO Dep.

The FEMP Update, published quarterly by the Office of Federal Energy Management Programs. (FEMP), provides information that will assist federal managers in their energy management responsibilities. The Update is distributed primarily to federal facility and energy management personnel.

12897 (SR/NES–90-02) **Energy consumption and conservation potential: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 21 Dec 1990. 248p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009200. Source: OSTI; NTIS; GPO; GPO Dep.

This report presents a detailed assessment of the conservation potential in the end-use energy sectors of the U.S. economy. Three projections are presented. The first projection, the reference case, is an update and extension of the base case projection in the Energy Information Administration (EIA) publication titled the Annual Energy Outlook 1990 (AEO). The second and third projections present a High Conservation (HC) excursion and a Very High Conservation (VHC) excursion. The HC and VHC excursions illustrate the potential energy savings resulting from increased conservation in each of the end-use demand sectors: buildings (both residential and commercial), transportation, and industry. Increased conservation is achieved by increasing the penetration of existing and improved energy-efficient equipment and structures, or in the transportation sector, by increasing the penetration of more efficient alternatively fueled vehicles. The Modeling Subgroup was responsible for data evaluation, development of detailed assumptions regarding technologies and penetration rates, and evaluation of the modeling results. The principal finding of this study is that for the same level of energy services (heating, cooling, etc.) that are enjoyed today by residential, commercial, and industrial users, and with modest reductions in vehicle travel, if specific technologically based conservation initiatives are successful, and can be placed into service in every sector and end-use energy system, then significant energy savings could be achieved over the next 40 years. While the benefits of these savings might be significant (generally 20 to 30 percent of U.S. reference case consumption could be saved by 2030), further work is necessary to quantify the costs of these savings in each sector. This study was not able to say definitively that these initiatives would necessarily have positive net benefits. 56 refs., 46 figs., 109 tabs.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 12406

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 12527, 12616, 12617, 12618, 12619, 12620, 12621, 12622, 12623, 12624, 12625, 12626, 12627, 12892

12898 (WSRC-MS–90-280-Rev.1) **Integration of statutory provisions of NEPA, RCRA, and CERCLA at the Savannah River Site: Revision 1.** Gordon, D.E.; Thomas, R.; Shedrow, C.B.; Wilson, M.P. Westinghouse Savannah River Co., Aiken, SC (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-910270–29-Rev.1: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009337. Source: OSTI; NTIS; GPO Dep.

Cleanup activities at Department of Energy facilities in compliance with hazardous waste regulations must also satisfy the procedures for environmental impact review required by the Council on Environmental Quality. A strategy for integrating the provisions of the National Environmental Policy Act (NEPA) with those of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) has been developed at the Savannah River Site. The approach for integrating these statutory provisions takes advantage of existing NEPA documentation and the preliminary characterization data generated by RCRA/CERCLA. In addition, it relies on the strategic timing of supplemental NEPA documentation on environmental restoration and waste management activities. 5 refs., 2 figs., 1 tab.

2940 Fossil Fuels

Refer also to citation(s) 12282, 12404, 12406, 12407, 12408, 12409, 12410, 12421, 12422, 12897

12899 (DOE/EIA–0219(89)) **International energy annual, 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Feb 1991. 180p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008249. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This report is prepared annually and presents the latest information and trends on world energy production, consumption, reserves, trade, and prices for five primary energy sources: petroleum, natural gas, coal, hydroelectricity, and nuclear electricity. It also presents information on petroleum products. Since the early 1980's the world's total output of primary energy has increased steadily.

The annual average growth rate of energy production during the decade was 1.9 percent. Throughout the 1980's, petroleum was the world's most heavily used type of energy. In 1989, three countries–the United States, the USSR, and China–were the leading producers and consumers of world energy. Together, these countries consumed and produced almost 50 percent of the world's total energy. Global production and consumption of crude oil and natural gas liquids increased during the 1980's, despite a decline in total production and demand in the early part of the decade. World production of dry natural gas continued to rise steadily in the 1980's. For the last several years, China has been the leading producer of coal, followed by the United States. In 1989, hydroelectricity supply declined slightly from the upward trend of the last 10 years. Nuclear power generation rose slightly from the 1988 level, compared with the marked growth in earlier years. Prices for major crude oils all increased between 1988 and 1989, but remained well below the price levels at the beginning of the decade. 26 figs., 36 tabs.

12900 (DOE/EIA–0538(90/91-23)) **Winter fuels report, week ending March 1, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 7 Mar 1991. 64p. Sponsored by USDOE,. Order Number DE91008845. Source: OSTI; NTIS; GPO; GPO Dep.

This report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and state and local governments on the following topics: distillate fuel oil net production, imports and stocks for all PADD's and product supplied on a US level; propane net production, imports and stocks for Petroleum Administration for Defense Districts (PADD), 1, 2, and 3; natural gas supply and disposition and underground storage for the United State and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those states participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United States and selected cities; and US total heating degree-days by city. 34 figs., 12 tabs.

12901 (DOE/FE–0214P) **The Strategic Petroleum Reserve.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Jan 1991. 16p. Sponsored by USDOE,. Order Number DE91007869. Source: OSTI; NTIS; GPO Dep.

The Strategic Petroleum Reserve program was set into motion by the 1975 Energy Policy and Conservation Act (EPCA). By 1990, 590 million barrels of oil had been placed in storage. Salt domes along the Gulf Coast offered ideal storage. Both "sweet" and "sour" crude oil have been acquired using various purchase options. Drawdown, sale, and distribution of the oil would proceed according to guidelines set by EPCA in the event of a severe energy supply disruption. (SM)

12902 (DOE/FE–0217P) **Clean coal technology: The new coal era.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Jan 1991. 39p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008478. Source: OSTI; NTIS; GPO Dep.

The term "clean coal technology" entered the energy vocabulary in the 1980s. It describes a new generation of advanced coal technology, environmentally cleaner and in many cases more efficient and less costly than conventional coal-burning processes. These new power generating and pollution control concepts are the products of years of research and development in hundreds of government and private laboratories throughout the world. Their emergence in the 1980s is bringing about a new coal age – one that not only responds to past problems with some of the most sophisticated technology available in the world today but offers a bright future for coal as well. Coal is the nation's most plentiful fossil fuel. One quarter of all the world's known coal lies within US borders. Coal also is an energy bargain. Even with the sharp decline in world oil and gas prices in the mid-1980s, coal has remained the least expensive fossil fuel in the US. In the future, coal can do more to help this country and our trading partners grow economically while enhancing national energy security – if it can be used in greater amounts without endangering the Earth's fragile ecology. The new suite of advanced, clean coal technologies will help achieve that objective. They will ensure that the US can continue using its most abundant energy resource while maintaining a commitment to a clean, healthy environment.

12903 (DOE/FE–0219P) **Clean Coal Technology Demonstration Program: Program update 1990 (As of December 31, 1990).** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Feb 1991. 158p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008636. Source: OSTI; NTIS; GPO Dep.

The Clean Coal Technology Demonstration Program (also referred to as the CCT Program) is a government and industry cofunded technology development effort to demonstrate a new generation of innovative coal utilization processes in a series of full-scale, "showcase" facilities built across the country. The program will take the most promising of the advanced coal-based technologies and, over the next decade, move them into the commercial market place through demonstration. This report, Program Update 1990, is the fourth in a series of annual updates on the status of the program, progress being made in the projects, and the status of other activities being conducted in support of the demonstration program. The first chapter of this 1990 program update contains an explanation of the role of the CCT Program in reducing or eliminating the economic and environmental barriers that limit the full consideration of coal as an energy resource. Chapter 2 explains the process used to solicit, evaluate, and select proposals for demonstration projects. Chapter 3 addresses the financial aspects of the program, including project funding, cost-sharing, and provisions for recoupment of government costs. Chapter 4 reports the progress and status of the demonstration projects constituting the program. Chapter 5 addresses the environment aspects of the program and the NEPA process as it applies to the CCT Program. Chapter 6 contains a summary of program outreach efforts and the communication of technical information about the technologies and demonstration projects to a broad range of groups and persons who will be involved in decisions about future commercial application. Chapter 7 is a compilation of fact sheets for each demonstration project. 20 figs.

12904 (ETDE-mf–1756454) **Coal mining in the energy policy of the Federal Republic of Germany in 1989.** Statistik der Kohlenwirtschaft e.V., Essen (Germany, F.R.). Sep 1990 95p. (In German). Order Number DE91756454. Source: OSTI; NTIS (US Sales Only).

After an introductory text divided into the sections energy and coal market, coal mining and brown coal mining, extensive tables containing the most important characteristic figures of German coal mining are shown. To compare the last figures of 1986, figures from previous years are referred to (partly even going back to 1970). (UA).

2960 Electric Power

Refer also to citation(s) 12617, 12619, 12620, 12622, 12623, 12624, 12625, 12626, 12627, 12897, 12899, 12910

12905 (CONF-9104196–1) **Analytical foundations of successful utility DSM programs.** Hirst, E. Oak Ridge National Lab., TN (USA). [1991]. 14p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From 3. National Association of Regulatory Utility Commission (NARUC) conference on integrated resource planning; Sante Fe, NM (USA); 8-10 Apr 1991. Order Number DE91009119. Source: OSTI; NTIS; GPO Dep.

Will utility demand-side management (DSM) programs fulfill their promise to provide large amounts of cost-effective and environmentally benign energy and capacity resources? Much depends on our success in measuring accurately the performance of these programs and in clearly and consistently defining the terms that characterize such programs. This paper discusses these analytical issues and then present a scenario showing how much DSM programs could accomplish if we build a solid foundation of credible data. 10 refs., 5 figs., 4 tabs.

12906 (DOE/EIA–0437(89)/2) **Financial statistics of selected publicly owned electric utilities 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal,

Nuclear, Electric and Alternate Fuels. 6 Feb 1991. 400p. Sponsored by USDOE,. Order Number DE91007885. Source: OSTI; NTIS; GPO; GPO Dep.

The Financial Statistics of Selected Publicly Owned Electric Utilities publication presents summary and detailed financial accounting data on the publicly owned electric utilities. The objective of the publication is to provide the Federal and State governments, industry, and the general public with data that can be used for policymaking and decision making purposes relating to publicly owned electric utility issues. 21 tabs.

12907 (EFI-TR--3678) **The power pooling model: A tool for operation and development planning.** Haugstad, A.; Reinertsen, T.; Johannesen, A.; Green, T.; Botnen, O.J. Energiforsyningens Forskningsinstitutt A/S, Trondheim (Norway). Feb 1990. 115p. (In Norwegian). Order Number DE91753013. Source: OSTI; NTIS (US Sales Only).

This is program system for long term production and development planning in hydro dominated electric power supply systems, consisting of two or more cooperating subsystems. The report describes how the components of the supply system are represented in the model, how the cooperating subsystems are modeled, the philosophy and the assumptions behind the applied optimization method and how the model may be used in development and operation of hydro based electric power systems. 2 refs., 49 figs., 2 tabs.

2980 Consumption and Utilization

Refer also to citation(s) 12897, 12899

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 12616, 12617, 12618, 12619, 12620, 12621, 12622, 12623, 12624, 12625, 12626, 12627, 12629

12908 (ENEA-RTI-STUDI-STRAT--90-10) **Renewable energy sources and technologies: Their potential application for agricultural production and product processing in Tanzania.** Sambali, J.J.S. ENEA, Rome (Italy). Oct 1990. 90p. Order Number DE91752882. Source: OSTI; NTIS (US Sales Only).

Adequate food supplies and a reasonable quality of life require energy, both non-renewable (commercial) and renewable (non-commercial) forms. Non-renewable energy is expensive at any price for the rural communities of most developing countries. The rural sector of these countries (Tanzania included) depend heavily on renewable energy sources, especially, biomass for household activities. This is a report on renewable energy sources (emphasizing potential application in agricultural production and product processing), current renewble energy technologies, end uses and the relevant economic aspects of these sources. Designed to help Tanzania and other developing countries in their quest to ensure adequate food supplies for their citizens, the report is divided into four sections: (1) world agricultural production (emphasis being on the role of energy and fertilizers in the promotion and development of agriculture); (2) Tanzania's energy situation, including energy sources and utilization, agricultural production and product processing; (3) renewable energy sources, the technologies, the end uses and the relevant economics; (4) the constraints and limitations of these technologies/techniques and suggestions on how to overcome these problems.

12909 (NEI-DK--489) **Renewable energy sources in the energy system: System analysis.** Illum, K.; Lund, H.; Maeng, H. Aalborg Universitetscenter (Denmark). Inst. for Samfundsudvikling og Planlaegning. Jun 1990 35p. (In Danish). Contract TR-88.187. Order Number DE91752950. Source: OSTI; NTIS (US Sales Only).

The aim was to contribute to the development of a general model which could be used for calculating the reduction in fossil fuels consumption that could be achieved within a given energy system where a determinable extent of utilization of renewable energy sources took place. The method of analysis, a computerized model, is summarized and the results of the analyses are presented and discussed. Aspects concerning environmental impacts and energy conservation are included. (AB).

12910 (SR/NES--90-04) **Renewable energy excursions: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. Dec 1990. 27p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009202. Source: OSTI; NTIS; GPO; GPO Dep.

The analysis undertaken for the development of the National Energy Strategy (NES) examines several potential energy supply and demand scenarios over the period 1990-2030. Two primary documents useful to the analysis were (1) a compendium of renewable energy technology costs and performance data, and (2) a white paper prepared by a Department of Energy Interlaboratory Team. The first report describes the cost and performance assumptions used for the renewable technologies and the second report contains projections of hydropower and liquid fuels that were used as exogenous inputs to the projections described in this report. The two fundamental questions that were addressed are: (1) How much energy might be derived from renewable sources by 2030, under existing laws and regulations? and (2) By how much might that contribution be reasonably increased through acceleration in cost and performance improvements of renewable technologies and regulatory changes to foster the development of hydropower? The Excursion does not explicitly consider the effects of tax credits or other financial incentives for renewable energy forms or other programs or events that would change the costs of conventional fuels. Also, neither the Reference Case nor the Excursion considers the reasons for the improvement in renewable energy technology costs and performance. These improvements could be the result of an acceleration in historical trends, expanded research and development efforts, or technological breakthroughs. All forecasts are subject to a high degree of uncertainty, especially in the mid- and long-term. Both the Reference and Excursion forecasts assume rapid declines in the costs of the various renewable technologies. These declines in conjunction with rapid escalation of natural gas and oil prices lead to optimistic forecasts of renewable energy use. 11 refs., 1 fig., 3 tabs. (JF)

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 12872

3001 MHD Generators

Refer also to citation(s) 13142

12911 (DOE/PC/79680--T6) **Computer controlled MHD power consolidation and pulse generation system: Technical progress report, April 1988--September 1988.** Johnson, R. Montana State Univ., Bozeman, MT (USA). Dept. of Electrical Engineering. [1988]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79680. Order Number DE91008519. Source: OSTI; NTIS; GPO Dep.

The major goal of this research project is to establish the feasibility of a power conversion technology which will permit the direct synthesis of commercial frequency power by means of computer control. The power input to the conversion system is assumed to be a MHD Faraday connected generator which may be viewed as a multi-terminal d.c. source. This consolidation/inversion process is referred to subsequently as Pulse-Amplitude-Synthesis-and-Control (PASC). A secondary goal is to deliver a controller subsystem consisting of a computer, software, and computer interface board which can serve as one of the building blocks for a possible phase 2 prototype system. This report period work covers the second six months portion of the project and includes discussions on the following areas: (1) Integration and coding of the PASC control computer and hardware/software interface. (2) Numerical integration methods for simulation of PASC operation on digital computers. (3) Additional simulation results for the PASC transformer, using a modified NASA overlapped pulse superposition

technique. (4) Project Hardware Construction Summary. (5) Preliminary Data Acquisition Design for PASC Feasibility Demonstration Test. 4 refs., 3 figs.

12912 (DOE/PC/88928–T2) **Corrosion and arc erosion in MHD channels: Quarterly progress report, April–June 1990.** Rosa, R.J. (Montana State Univ., Bozeman, MT (USA). Dept. of Mechanical Engineering); Pollina, R.J. Montana State Univ., Bozeman, MT (USA). Dept. of Mechanical Engineering. 30 Jul 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88928. Order Number DE91008527. Source: OSTI; NTIS; GPO Dep.

The objective of this task is to study the corrosion and arc erosion of MHD materials in a cooperative effort with, and to support, the MHD topping cycle program. Materials tested in the Avco Research Laboratory/Textron facility, or materials which have significant MHD importance, will be analyzed to document their physical deterioration. Conclusions shall be drawn about their wear mechanisms and lifetime in the MHD environment with respect to the following issues; sulfur corrosion, electrochemical corrosion, and arc erosion. The impact of any materials or slag conditions on the level of power output and on the level of leakage current in the MHD channel will also be noted, where appropriate. The work performed to date in the analysis of channel gas side materials has served to identify and clarify the respective environments to which the various materials are subjected and identified a performance ranking of materials. For high voltage intercathode gaps, which show the most severe wear, the materials rank in the order from best to worst: W, Mo, 90WCu, 97W2Fe1Ni, 75WCu, and Cr. We have shown data which indicates that lifetime is sensitive to gap voltage. Therefore for conditions under which iron oxide addition maintains low voltage intercathode gaps 75WCu becomes an excellent cathode material.

12913 (ETDE-IT–91-15) **230 MW(t)gas fired MHD retrofit: preliminary design results.** Negrini, F.; Avanzini, P.G.; Bedogni, V.; Bellofatto, O.; Martini, Marco; Repetto, F.; Capra, Marcello; Conte, C.; Gentilini, A. ENEA, Rome (Italy); Bologna Univ. (Italy); Ansaldo SpA, Genoa (Italy); Snamprogetti SpA, San Donato Milanese (Italy). 1989. 12p. (CONF-891226–4: 10. international conference on MHD electrical power generation, Tiruchirapalli (India), 4-8 Dec 1989). Order Number DE91752928. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at 10th international conference on MHD electrical power generation (Tiruchirapalli, 4-8 Dec 1989).

The reference plant in this MHD retrofit study is the ENICHEM thermal power plant in Ravenna, Italy. It consists of 4 boilers, one of which is in state of maintenance. The retrofit will be realized on the latter. The main features of the boilers are: 270 t/h steam power, 120 bars pressure s.h.o., 540 degrees C superheating temperature. Some of the steam obtained feeds a 37.5 MWe back pressure turbine, the rest of it is transferred to the plant at different pressure levels. The reference design calls for a range of plasma equal to 45 kg/s for a total of 231MW heat input, 91 MWt of which for the pre-heating of the air and the remaining 140 MWt to the heater. The net electric power results to be 66.6 MWe, 37.7 MWe of which from the existing alternator, 33.7 MWe from the inverter of the MHD channel while 4.6 MWe are absorbed by the auxiliaries; moreover, a total amount of 15.2 MWe of process steam is given to the plant. The net efficiency obtained is equal to 35.4% against 29.9% of the existing unit. Main process choises and process parameters are identified and discussed in this paper along with the expeted environmental impact and overall project costs.

3003 Thermoelectric Generators

12914 (CONF-910116–20) **Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF).** Johnson, E.W. (Lamb Associates, Inc., Rockville, MD (USA)). EG and G Mound Applied Technologies, Miamisburg, OH (USA); Lamb Associates, Inc., Rockville, MD (USA). [1991]. 8p. Sponsored by USDOE,. DOE Contract AC04-88DP43495. From 8. symposium on space nuclear power systems; Albuquerque, NM (USA); 6-10 Jan 1991. Order Number DE91008131. Source: OSTI; NTIS; GPO Dep.

In heat source systems of the type C/Ir/PuO_2, ingrowth of CO and CO_2 is evident. This is due to a cyclical reaction between the C and PuO_2 constituents. Gas tap results show that repeated exchanges using a pure inert gas backfill reduces the CO/CO_2 ingrowth rate. Also, the temperature experienced during Radioisotope Thermoelectric Generator (RTG) processing reduces further the effect such that normal RTG storage temperatures do not result in this deleterious effect. A 36-station vacuum/inert gas manifold has been developed at Mound Facility to serve as a Module Reduction and Monitoring Facility (MRMF) for up to 68 GPHS-type heat source modules. This method of storage effectively prevented atmospheric contamination of modules while reducing the CO/CO_2 ingrowth rate. This paper describes in detail the theoretical, practical, facility, and quality/reliability aspects of this processing facility that has supported the Galileo and Ulysses RTG programs. 5 refs., 3 figs., 1 tab.

3005 Fuel Cells

12915 (CONF-901073–16) **Electrochemical properties of lithium ferrite as an anode material in MCFC.** Lu, Shu-Hwa. Institute of Gas Technology, Chicago, IL (USA). [1990]. 13p. Sponsored by Ins. From 178. meeting of the Electrochemical Society (ECS); Seattle, WA (USA); 14-19 Oct 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The electrochemical properties of lithium ferrite in the fuel environment were studied. Half-cell tests were conducted using dense electrodes submerged in a pool of molten carbonate through which fuel gases were being sparged. The exchange current density, which is a measure of catalytic activity of electrodes, for the anodic reaction was determined to be about an order of magnitude below that of nickel metal. This explains the higher polarization observed with pure lithium ferrite anodes. Cyclic voltammetric measurements were also performed on the dense electrode. An oxidation wave was recorded at a potential about 100 mV positive of the oxidation wave for the fuel reaction. This wave is tentatively being attributed to the oxidation of iron (2) to iron (3) and may be responsible for the loss in catalytic activity observed under high load. 5 refs., 8 figs.

12916 (ENET–8900129/1) **Modelling and dimensioning of a catalyst bed for the water vapour-methanol-reforming of an alkaline methanol-oxygen-fuel cell.** Wickli, A. (Eidgenoessische Technische Hochschule, Zuerich (CH). Abt. fuer Chemie). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jul 1989. 56p. (In German). Order Number DE91749216. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Kinetic measurements with the Girdler G66B catalyst proved the basis for modelling and sizing experiments using the catalyst bed height and operating temperature as variables. The tests were conducted in a microreactor at a temperature of 160-200 C and under standard pressure. The established reaction rate constants were found to be two and a half times higher than values in the literature. The long-term stability of the catalyst was unsatisfactory, the activity decreased to 53% of the initial value after 50 hours of operation. The catalyst requirement for internal reforming was found to differ from that for external reforming. 39 figs., 9 tabs., 29 refs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

Refer also to citation(s) 12371, 12385, 12386, 12387, 12895, 12952, 13012, 13013, 13322, 13456, 13553

12917 (BFR-D–17-90) **Electrical energy savings in office buildings.** Holtz, M. (Architectural Energy Corporation, CO (US)). Swedish Council for Building Research, Stockholm (Sweden). 1990. 251p. Project BFR-881081-6. Order Number DE91753066. Source: OSTI; NTIS (US Sales Only).

This study examines the use of energy-saving technologies to reduce energy consumption and peak demand in office buildings. The potential electrical energy savings of various technologies

have been examined for three types of office buildings. 1. An existing building with design features typical of buildings constructed in the 1960s. 2. A new building with a variable air volume (VAV) HVAC system. 3. A new building with a fan coil HVAC system. Four major objectives were pursued: 1. characterize the electric energy use of new and existing office buildings, 2. identify energy-saving technologies that are appropriate to these buildings, 3. quantify the potential for savings in electrical energy consumption, peak demand and total energy cost and 4. recommend further action to promote the goals of the Swedish national energy policy. The results show large potential savings for some of the lighting, HVAC and glazing technologies. (author).

12918 (BFR-D–18-90) **Efficient use of electricity in the Swedish commercial building sector.** Morse, F.H. (Fredrick H Morse Consultant, Washington, DC (US)). Swedish Council for Building Research, Stockholm (Sweden). 1990. 138p. Project BFR-881082-2. Order Number DE91753068. Source: OSTI; NTIS (US Sales Only).

The objective of this study was to provide an assessment of the technical and economic opportunities for increasing the efficiency of electrical energy use in the commercial building sector in Sweden. Information on electrical energy use in the commercial building sectors in Sweden and the United States and the status of new electrical energy-efficient technologies in use in the United States was reviewed. The programs conducted in the United States to promote the use of electricity efficient products were reviewed and the most effective were described. Recommendations were made on promising technologies, promotional programs, and R and D opportunities for Sweden's commercial buildings sector. (author).

12919 (BFR-R–88-90) **Ground water for heat pump systems: Evaluation of overutilization, Malmoe and Ystad.** Jeppsson, H. (VIAK AB, Malmoe (SE)); Landberg, J. Swedish Council for Building Research, Stockholm (Sweden). 1990. 70p. (In Swedish). Project BFR-860227-5. Order Number DE91753073. Source: OSTI; NTIS (US Sales Only).

The heat requirement for apartment houses and similar large buildings normally is so large that the energy extraction from ground heat systems influences surrounding property owners. In areas with many ground water heat pumps systems these may influence each other thermally. To avoid overutilization, the local governments are trying to find recommendations for maximum energy output per area unit. Field tests have been made that indicate minor cooling effects in a few facilities in Malmoe, while the conditions in Ystad is more troublesome. However, this investigation shows that other problems on the cold side of the heat pumps, i.e. clogging, corrosion, and evaporator breakdowns, have a more pronounced influence on the reliability of the heat pump systems. Two different solutions to the problems are discussed. Enlargement of the wells to the aquifer of heat recharging by the use of solar collectors, air source, heat pumps or cooling systems. (U.W.).

12920 (BNL–45467) **The distribution of common construction materials.** Lipfert, F.W.; Daum, M.L. Brookhaven National Lab., Upton, NY (USA). Apr 1990. 133p. Sponsored by USDOE,. DOE Contract AC02-76CH00016. Order Number DE91008262. Source: OSTI; NTIS; GPO Dep.

Degradation of construction materials due to acid deposition is largely an economic issue; its importance is measured in dollars. To estimate these costs requires information on the distribution of various types of construction materials, i.e., the "stock at risk" in the built environment, in addition to appropriate dose-response functions and many other data inputs. The data on material (chemical) composition must be sufficiently detailed to permit estimates of deterioration in response to acid deposition, while locations of these materials must be keyed to data on rates of acid deposition: past, present, and future. Regional data are needed, so as to facilitate economic damage estimates for large portions of the United States consistent with the assessment of regional control of deposition. Assessment calculations for only a single city will inevitably be of questionable validity for the regional problem. Such an assessment may be regarded as a problem in mapping: using economic dose-response functions and the geographic distributions of the materials at risk, the ultimate goal is to map the distribution of rates of acidic deposition into the distribution of economic damages (or the distribution of benefits of control of acid deposition). This report (Section 1) focuses on the identification, evaluation, and interpretation of data describing the distributions of exterior construction materials. We describe the data needs, existing data sources, and research methods which have been used, and summarize the current findings. We emphasize the underlying bases for uses of different materials in the US economy at both regional and local levels; our intent is to provide guidance for future economic assessments to acquire the data needed in the most cost-effective ways. 101 refs., 24 figs.

12921 (CONF-9004281–1) **Gas-fired heat pumps.** Wurm, J.; Kountz, K.J. Institute of Gas Technology, Chicago, IL (USA). [1990]. 35p. Sponsored by Ins. From Asian natural gas II - a brighter '90s; Singapore (Singapore); 9-11 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

Heat-activated and engine-driven heat pumps have been used in industrial processes for 60 years. However, their introduction into the large and competitive space-conditioning equipment market was attempted on a larger and organized scale, using new gas-fired machinery since the 1960's. In the late 1970's and early 1980's the offensive on this market segment, dominated by electric systems, was renewed on a broader scale although numerous products of that period have been, and are being, brought to the marketplace only with subsidies. The recent research activity is still both intensive and extensive, supporting the programs that are aimed at improving the system competitiveness in the framework of an advantageous gas energy market. A selected group of programs are described in our paper vis-a-vis the historical developments of the gas heat-pump technology. The three main supporters of the technology development, Japan, Europe, and the United States, have defined short- and long-term programs. Each country may have a different preference in a technology segment while the objectives are the same, that is, developing less costly, better performing, and more reliable equipment. There are significant signs that the better defined, and internationally intertwined, marketing offensive may be successful. As in the past, the activity is contributing to the advancement of space-conditioning technology in general. 22 refs.

12922 (CONF-9007202–1) **Recent advances in gas-fired heat pumps.** Wurm, J. Institute of Gas Technology, Chicago, IL (USA). [1990]. 18p. Sponsored by Ins. From Workshop on energy conservation and industrial and commercial aplications of heat pumps; Cuernavaca (Mexico); 4-6 Jul 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

Heat-activated and engine-driven heat pumps have been used in industrial processes for 60 years. However, their introduction into the large and competitive space-conditioning equipment market was attempted on a larger and organized scale, using new gas-fired machinery since the 1960s. In the late 70s and early 80s the offensive on this market segment, dominated by electric systems, was renewed on a broader scale although numerous products of that period, have been, and are being, brought to the marketplace only with subsidies. The recent research activity is still both intensive and extensive, supporting the programs that are aimed at improving the system competitiveness in the framework of an advantageous gas energy market. A selected group of programs are described in our paper vis-a-vis the historical developments of the gas heat-pump technology. The three main supporters of the technology development, Japan, Europe, and the United States, have defined short- and long-term programs. Each country may have a different preference in a technology segment while the objectives are the same, that is, developing a less costly, better performing, and more reliable equipment. There are significant signs that the better defined, and internationally intertwined, marketing offensive may be successful. As in the past, the activity is contributing to the advancement of space-conditioning technology is general. 13 refs., 9 figs., 1 tab.

12923 (DOE/CE/21003–T2) **Use of energy management and control systems for performance monitoring of retrofit projects: First quarterly progress report, September 26, 1990–December 26, 1990.** Claridge, D.E.; Haberl, J.S. Texas A and M Univ., College Station, TX (USA). Energy Systems Lab. [1990]. 16p. Sponsored by USDOE,. DOE Contract FG01-90CE21003. Order Number DE91008529. Source: OSTI; NTIS; GPO Dep.

The Texas LoanSTAR Monitoring and Analysis Program (MAP) is responsible for monitoring energy conservation retrofits at various sites throughout Texas. An important part of this task is gathering pertinent energy consumption and weather data for the site to determine the effectiveness of the retrofit projects. For this purpose, LoanSTAR researchers have installed dedicated data loggers at over 30 retrofit sites. These devices are designed specifically to collect energy and/or weather data from appropriate sensors, store them, and transmit them via a telephone modem when polled, a task they perform quite well. Although data loggers have proven effective in the data gathering process, it has been observed that many of their functions may be accomplished by Energy Management and Control Systems (EMCSs). While it is obvious that an EMCS should not be installed strictly for monitoring energy usage, an existing EMCS may provide an alternative monitoring solution to the installation of a dedicated data logger in sites so equipped. The purpose of this project is to determine the monitoring capabilities of various EMCSs, and to identify advantages and disadvantages of utilizing existing systems for energy monitoring at LoanSTAR sites.

12924 (DOE/EH/79079–H1) **Indoor air quality environmental information handbook: Combustion sources: 1989 Update.** EA-Mueller, Inc., Baltimore, MD (USA); Brookhaven National Lab., Upton, NY (USA). Jun 1990. 325p. Sponsored by USDOE,. DOE Contract AC01-88EH79079 ;AC02-76CH00016. Order Number DE91005691. Source: OSTI; NTIS; GPO Dep.

This environmental information handbook was prepared to assist both the non-technical reader (i.e., homeowner) and technical persons (such as researchers, policy analysts, and builders/designers) in understanding the current state of knowledge regarding combustion sources of indoor air pollution. Quantitative and descriptive data addressing the emissions, indoor concentrations, factors influencing indoor concentrations, and health effects of combustion-generated pollutants are provided. In addition, a review of the models, controls, and standards applicable to indoor air pollution from combustion sources is presented. The emphasis is on the residential environment. The data presented here have been compiled from government and privately-funded research results, conference proceedings, technical journals, and recent publications. It is intended to provide the technical reader with a comprehensive overview and reference source on the major indoor air quality aspects relating to indoor combustion activities, including tobacco smoking. In addition, techniques for determining potential concentrations of pollutants in residential settings are presented. This is an update of a 1985 study documenting the state of knowledge of combustion-generated pollutants in the indoor environment. 191 refs., 51 figs., 71 tabs.

12925 (DOE/SF/15927–T4) **Optics and materials research for controlled radiant energy transfer in energy efficient buildings: Annual report of research, 1 January–31 December 1990.** Goldner, R.B.; Haas, T.E. Tufts Univ., Medford, MA (USA). Electro-Optics Technology Center. [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-85SF15927. Order Number DE91006763. Source: OSTI; NTIS; GPO Dep.

During the past year important progress has been made in regard to uncovering and solving several key problems with respect to developing a lithium-based, monolithic, completely inorganic, reflectivity-modulating, robust electronic window to the point where its technology transfer can be smoothly accomplished. The major problems remaining to be solved are: (a) develop a counterelectrode layer which, as part of the multilayer window structure, is optically and electrochemically satisfactory; (b) develop an optically transparent lithium ion/water vapor blocking layer to prevent the irreversible loss of lithium; (c) develop an optically transparent capping layer; and (d) develop a recipe(s) necessary to obtain robust prototype electrochromic windows by a production-worthy process, such as reactive magnetron sputtering. 1 tab.

12926 (ENET–8900004/1) **Energy saving refrigerator.** Nipkow, J. (ARENA, Arbeitsgemeinschaft Energie-Alternativen, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Apr 1990. 25p. (In German). Order Number DE91749225. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The design and operation of modern refrigerators are described; the energy balance of a refrigerator is dealt with and suggestions are made on how to reduce the energy consumption. The results of measurements taken from a production refrigerator are communicated and the energy-saving potential is estimated. Uses of vacuum insulation are discussed. figs., tabs., 21 refs.

12927 (ENET–8900645/1) **Computer simulation of heating systems with air-to-water heat pumps.** Afjei, T. (Swiss Federal Institute of Technology, Institute of Energy Technology, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 8p. Order Number DE91749210. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The heat pump simulation program YUM (yearly utilization model) has been developed to be used as a design tool for engineering offices to optimize the seasonal performance factor (SPF) of heat pump heating systems (HPHS) by means of simulation on any IBM compatible PC. With meteorological data, provided in an appropriate format, YUM can be used for optimizing the SPF of HPHSs, dependant on ambient conditions, controller settings and components' size, to complete the conventional design process of HPHSs with computer simulation, to get a benefit in regard to the SPF and thus electricity costs. It could be shown that, just by means of a different storage tank control, the HPHS's SPF could be improved by several percent. (author) 5 figs., 10 refs.

12928 (ENET–8900645/2) **YUM: a yearly utilization model for calculating the seasonal performance factor of electric driven heat pump heating systems. Technical form.** Afjei, T. (Swiss Federal Institute of Technology, Institute of Energy Technology, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 76p. Order Number DE91749211. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

With weather data, provided in an appropriate format, YUM can be used for optimizing the seasonal performance factor (SPF) of heat pump heating systems (HPHS), dependant on ambient conditions, controller settings and components' size, to complete the conventional design process of HPHSs with computer simulation, to get a benefit in regard to the SPF and thus electricity costs. YUM's models are based on algebraic algorithms that are calculating the steady-state performance of the components in the HPHS, i.e. AWHP, mixing valve (AWHP-tank), stratified storage tank, electric auxiliary heater, mixing valve (tank-user) and a simplified building model (SBM) with integrated heating system. The AWHP-model is based on manufacturer data and does corrections for frost/defrost and cycling losses. The SBM considers a building load, derived from a straight line law, corrected for internal and solar gains and a space heating system with different heater types, based on the heater over temperature law, capacity controlled by changing the mass flow rate with thermostatic valves. A validation of the AWHP model delivered a deviation of apr. 3% of the SPF, 6.6% of the heat gain and 12.5% of the electricity consumption; the SPF deviation is lower due to compensation effects of heat gain and electric power consumption over the heating season. These errors are tolerable for optimization tasks, because different configurations will have similar errors. Since YUM is built up on modules, components for water-to-water or ground-coupled heat pumps could be inserted. Thus, with given hourly data for the heat source temperature, comparisons between different heat pump types for the same locations could be done. (author) 19 figs., 13 tabs., 18 refs.

12929 (ENET–8900645/3) **YUM: yearly utilization model: A simulation program for calculating the seasonal performance factor of electric driven air-water-heat pump heating systems. User manual.** Afjei, T. (Swiss Federal Institute of Technology, Institute of Energy Technology, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 22p. (In German). Order Number DE91749212. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

This report is a supplement to the report ENET–8900645/2. 2 figs., 2 refs.

12930 (ETDE-mf–1759224) **Electricity consumption in households. Energy saving potential, economics and future developments.** Ebel, W. Institut Wohnen und Umwelt GmbH, Darmstadt (Germany, F.R.). Jan 1989 83p. (In German). Order Number DE91759224. Source: OSTI; NTIS (US Sales Only).

Electricity is used for services like washing, cooking, dishwashing drying, cooling, refrigeration, light, service water and space heating. Depending on the technology one needs more or less energy to achieve this purpose. The power consumption of electric household appliances has dropped more and more over the last ten years. As there are still many older appliances a saving effect is created when these appliances are replaced. But the energy saving potentials are by no means exhausted. This is proved when one compares the consumption of all the appliances available on the market. Some appliances consume three times the energy of others. This book introduces a method which helps to estimate the average consumption of the appliances available on the market and the additional investment required to buy new energy-saving ones. From these data it is possible to judge whether the purchase of a new energy-saving device (replacing the old one) would be the economically sensible thing to do. The results for 1988 are quantified. The energetic standards of the 'market average 1988', 'best appliances on the market 1988', and 'state of the art 1988 (prototypes) are the basis for the model calculations for future developments of households power consumption, the results of which are contained in chapter 4. (orig./UA).

12931 (EUR–12694) **Improvement of COP of vapour compression heat pumps by using a new cycle: Final report.** McMullan, J.T. (Ulster Univ., Coleraine (UK). Centre for Energy Research); Masson, A.; Murphy, N.E.; Hewitt, N. Commission of the European Communities, Luxembourg (Luxembourg). Directorate-General for Science, Research and Development; Ulster Univ., Coleraine (UK). Centre for Energy Research. 1990. 45p. Sponsored by Com. Contract EN3E-0128/UK. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The objective of this research is to increase heat pump performance through improved methods of control, through the use of an improved operating cycle, through better understanding of the fundamental processes taking place in the evaporator and compressor. This report discusses these improvements.

12932 (EUR–12802) **SHADOWPACK-P.C. Version 2.0 user's guide.** Peckham, R.J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Ispra (Italy). Joint Research Centre. 1990. 55p. Sponsored by Commission of the European Communities, Brussels (Belgium). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The SHADOWPACK-P.C. package is designed to run on IBM personal computers and compatibles under the DOS operating system. The program allow the user to create a 3D model of a building or group of buildings and then analyse the effects of shading on the solar energy received on the various faces of the model, or on the ground plane. A typical sequence in such an analysis would be to first create the model using the interactive program ICON, and save it on a sequential data file. A qualitative appraisal of the overall shading situation can be obtained using the graphical display facilities of ICON, varying the viewpoint and time of day and year for the shading calculation. Hard copies of these views can also be obtained using a dot matrix printer. Quantitative values for the energy received on particular faces of interest can be tabulated with the programs SHADEN and GLOBAL, and, if necessary, contour plots of the distribution of radiation over individual faces can be created with ISOSUN. 4 refs., 2 figs.

12933 (GB–290) **An assessment of the benefits of heat storage in central heating systems.** Department of Energy, London (UK). Energy Efficiency Office; Cranfield Inst. of Tech., Bedford (UK); British Gas PLC, London (UK); Energy Technology Support Unit, Harwell (UK). Aug 1986 77p. (RD–9). Order Number DE91752777. Source: OSTI; NTIS (US Sales Only).

This report describes the benefits of interposing a thermally-insulated heat store in the circuit between a central-heating boiler and a hot water heat-distribution system. The potential benefits are first discussed qualitatively; more precise predictions are then presented, based on simulations for the behaviours of a diverse range of central-heating systems. Energy savings in the range 5-15% and boiler size reductions of up to 60% appear to be feasible, both in small domestic systems and in larger systems in commercial or institutional buildings. Space and water heating are the major consumers of fuel in the UK. Hot water central-heating boilers are used to meet a large proportion of the demand. (author).

12934 (GB–307) **The benefits achieved by incorporating thermal storage in central heating systems: Results of the Spa School field trial.** Department of Energy, London (UK). Energy Efficiency Office. Aug 1987 59p. (RD–31/8). Order Number DE91752783. Source: OSTI; NTIS (US Sales Only).

Cranfield Institute of Technology and British Gas plc have undertaken a collaborative programme of studies of a system which interposes a heat store between a boiler and a central-heating distribution network. Preliminary computer indicated the inherent advantages of such a system. For the commercial and institutional building sector, the studies have culminated in a field trial of such a system at Spa School in London. This, and the preliminary investigation were supported financially, through ETSU, by the Energy Efficiency Office of the Department of Energy. At Spa School, a thermally-insulated 3200 litre hot water store was installed in the circuit between the existing modular boiler set and the hydronic "radiator" network. The pipework was arranged so that the heating system could be operated either as it existed originally, or in the storage mode; in the latter case two of the five modular boilers were valved off. After commissioning and premonitoring, the two configurations were operated alternately and their performances were monitored carefully during the 1985/86 heating season. (author).

12935 (GB–313) **The cost effectiveness of heat pumps in highly insulated dwellings: an assessment.** Butler, D.J.G. (Building Research Establishment, Watford (UK)). Department of Energy, London (UK). Energy Efficiency Office. Jul 1984 60p. (RD–3). Order Number DE91752789. Source: OSTI; NTIS (US Sales Only).

The report examines the cost-effectiveness of electrically driven air to air, air to water, and ground source to water heat pumps for space and domestic hot water heating in highly insulated dwellings. The report is based on a survey of commercially available domestic heat pumps and conventional alternative installed in an average highly insulated dwelling. Fossil fuel driven heat pumps are not considered as these units are not sufficiently developed commercially. The net present value method has been used to rank the cost-effectiveness of the available options, which is that used for assessment of other R and D options within government: cash flows discounted at 5% p.a. in real terms. The results have been developed to incorporate the effects of possible future tariff changes together with improvements in heat pump performance and reductions in heat pump capital and installation costs. (author).

12936 (GB–314) **An assessment of the cost effectiveness and potential of heat pumps for domestic hot water (only) heating.** Grigg, P.F. (Building Research Establishment, Watford (UK)). Department of Energy, London (UK). Energy Efficiency Office. Jul 1984 34p. (RD–2). Order Number DE91752790. Source: OSTI; NTIS (US Sales Only).

Heat pumps using an air source can be used for heating domestic hot water. The costs of various conventional alternative means for the provision of domestic hot water are assessed, based on available data on residential dhw usage in the UK and on published estimates of the efficiencies of conventional domestic water heaters. The costs and savings resulting from the use of a dhw (only) heating heat pump are similarly assessed, using data obtained from laboratory testing of the heating efficiency of a typical machine taking heat from the external air. (author).

12937 (LBL–28452) **Window nighttime U-values: A comparison between computer calculations and MoWITT measurements.** Klems, J.H.; Reilly, S. Lawrence Berkeley Lab., CA (USA). Nov 1989. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Mo-274. (CONF-900203–7: Winter meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA (USA), 11-14 Feb 1990). Order Number DE91009079. Source: OSTI; NTIS; GPO Dep.

The proper specification of window U-values has been a controversial area for many years, and current attempts to incorporate more careful treatment of windows into building standards and utility conservation programs and to define window energy labels has heightened the controversy. In a previous paper (Klems 1979) it was argued that current calculation techniques, as embodied in the computer program WINDOW, accurately represented field-measured window U-values, provided frame corrections and surface heat transfer coefficients were correctly estimated, and that in most cases the calculations were also consistent with test laboratory measurements on the same windows. This means that the calculation could serve both as a standard for deriving calculated U-values and as a method of comparing measurements made under different conditions to determine their consistency. This work has now been extended to form a joint US/Canadian collaborative effort to test current computer programs. For six windows the U-values measured with the MoWiTT under field conditions are compared with detailed U-value calculations for the same conditions using the programs WINDOW and ANSYS. There is good agreement between measurements and calculations. 7 refs., 3 figs., 4 tabs.

12938 (NEI-DK–481) **Energy in urban areas: Report on phase 1.** Hovedstadsraadet. Copenhagen (Denmark). Dec 1989 35p. (In Danish). Contract TR-87.635. Order Number DE91752940. Source: OSTI; NTIS (US Sales Only).

A presentation of 8 projects and ideas for technical and economical innovations aimed at energy conservation in urban areas and the possibilities for carrying them out. (CLS) 12 refs.

12939 (NEI-DK–492) **Total energy renovation: Renovation of apartment buildings to achieve heat conservation, electricity conservation and the use of renewable energy.** Viegand, J. Danmarks Tekniske Hoejskole. Lyngby (Denmark). Fysisk Lab. 3. Oct 1990 113p. (In Danish). Contract TR-86.690. Order Number DE91752955. Source: OSTI; NTIS (US Sales Only).

In Denmark 40% of the residental buildings are apartment buildings, of which 200,000 apartments are to be renovated according to the law on urban renewal and home improvement. This report describes 2 projects concerning houses built in 1964 and in 1860 and were the aim is to reduce the heat and electricity consumption in the buildings. The economy of carring on the projects and the possibilities for subsidies, grants and loans for the retrofitting are described. (CLS).

12940 (NEI-NO–116) **Energy savings and thermal climate in passive solar heated buildings: Evaluation - modelling - measurement.** Jacobsen, T. Trondheim Univ. (Norway). Norges Tekniske Hoegskole. 1989 140p. Order Number DE91746290. Source: OSTI; NTIS (US Sales Only).

The scope of the thesis is to review some passive solar systems with regard to the potential for energy savings, and the resulting thermal climate in passive solar buildings. The passive solar systems that are focused on, are isolated gain systems: Attached sunspaces for single family dwellings and glass covered atria for commercial buildings. In addition to introductory sections and summary, the thesis consists of seven self-contained parts, which may be read independently. The different parts are integrated through the emphasis on evaluation, modeling and measurements. The use of numerical models to perform parametric studies or to evaluate measurements, is an important aspect of all the parts.

12941 (SP–90-19) **Laboratory testing of heat pumps: Experience 1984-1986.** Fahlen, P. Swedish National Testing and Research Inst., Boraas (Sweden). 1990. 89p. Project BFR-830933-2. Order Number DE91753028. Source: OSTI; NTIS (US Sales Only).

This report presents experience from laboratory testing of heat pumps at the Swedish National Testing Institute during the period 1984-1986. A total of 186 heat pumps have so far been tested at the institute, 71 of which were tested during the investigation period. Comparisons between results obtained during different years show that performance data improved significantly up to 1983, there after, improvements have been marginal. Tested values for coefficients of performance and heating output are on average 10-12% below data given by manufacturers. Remarkably large deviations are shown to exist between different makes of heat pumps, concerning coefficient of performance, heating of sanitary hot water, defrosting efficiency and noise levels. As an example, the difference between the best and the worst tested results with the same operating conditions was 42% for the coefficient of performance of liquid/water heat pumps. For summer operating conditions, the best heat pumps is 150% better than the worst and for winter conditions, 160%. Additional results describing how various parameters such as flow rate, temperature, humidity, etc. affect the operation of heat pumps are presented in a large number of diagrams. Results are mainly given in the form of bar graphs showing the scatter of test results for the various sensitivity factors. A general observation is that heat pumps are now commercially mature products. Large amounts of research and development work by various manufacturers have resulted in heat pumps that in general, are efficient, reasonably quiet and reliable and with a rapidly decreasing price level of turnkey installations. However, there is still room for improvements, mainly concerning the efficiency of reliability of sanitary hot water heating and the defrosting of outside air heat exchangers. (author).

12942 (STF–11A90024) **Medium sized heat pumps for cold districts.** Eggen, G.; Frivik, P.-E. Divisjon Kulde NTH-SINTEF, Trondheim (Norway). Apr 1990. 15p. Order Number DE91753009. Source: OSTI; NTIS (US Sales Only).

The paper treats medium sized (50-500 kW) heat pumps for cold districts, with the focus on block centrals for heating only or heating and cooling. The emphasis is on Nordic or North European Climate. The first part is concerned with design aspects; relative size, components as well as systems are described and discussed. The second part reports on operating experience from three different plants in Norway: A heat pump/cooling plant for a hotel, with seawater as heat source; A heat pump plant for a commercial building/workshop with air as heat source; A heat pump plant for a museum, using waste water as heat source. Finally, the paper discusses market opportunities for such plants, including possible cost and coefficient of performance improvements, environmental advantages etc. 9 refs., 10 figs., 2 tabs.

12943 (VTT/LVIS–20009) **Absorption heat pump in heating and cooling systems of buildings.** Aho, I. (ed.). Valtion Teknillinen Tutkimuskeskus. Espoo (Finland). LVI-tekniikan Laboratorio. 1990. 97p. (In Finnish). Order Number DE91752988. Source: OSTI; NTIS (US Sales Only).

LVIS-2000 Research Programme.

This report focuses on the operation and applicability of absorption heat pumps (AHP) in building heating and cooling systems. Examples are presented on heating systems of residential buildings and a heating/cooling system of an office building. Despite the limitations of present AHP technology the examples assume AHPs which produce heat at an appropriate temperature level for each application. According to the calculations the primary energy saving potential of AHPs in building specific heat production is 20-40%. For AHPs coupled with district heating systems the primary energy saving potential can not be unambiguously defined because it is influenced by the production form of district heat, the influence of district heat demand on power generation etc. For the time being economical aspects limit the application potential of AHPs. The profitability of AHP investments is quite poor because of present energy prices, the price ratio of different energy forms and the high investment cost of AHP-systems. The environmental impact of AHPs depend on the fuel used in the generator. Using fuel oil or gas will decrease sulphur and particle emissions but might increase the emissions of NO_x and hydrocarbons because of the smaller size of combustion units. CFC-emissions will be decreased because AHPs apply alternative refrigerants.

3202 Transportation

Refer also to citation(s) 12965

12944 (ETDE/NL-mf–1747307) **Evaluation of the excise increase of engine fuels.** Bleijenberg, A.N.; Sips, H.W. Centrum voor Energiebesparing en Schone Technologie (CE), Delft (Netherlands). Nov 1990 41p. (In Dutch). Order Number DE91747307. Source: OSTI; NTIS (US Sales Only).

One of the aims of the Dutch government policy on traffic and transport is to control the car mobility. One of the policy means is a rise of excise. Therefore a study on the options and impacts of excise increase on engine fuels has been executed based on the existing literature and statistical data. First some background information for the benefit of decision making is given. This information concerns the development of fuel prices and excises, an overview of costs and benefits of car traffic and a few optional spendings of the extra government income from excise. Subsequently the possibilities for the Netherlands to raise the excises within the European Community are listed. The European regulations and the maximum acceptable difference of gasoline pump prices compared to the Dutch neighbouring countries impose limitations on the Dutch policy. Finally the most important consequences of an excise raise are discussed: fuel savings, decreased growth of the car traffic and economic effects. 6 figs., 26 refs., 8 tabs., 1 app.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 12319, 12380, 12382, 12383, 12384, 12411, 12581, 12583, 12589, 12590, 12599, 12894, 12908, 13044, 13238, 13239, 13483, 13918

12945 (CONF-870442–1) **Dispersed-phase adsorbents for biotechnology applications.** Scott, C.D. Oak Ridge National Lab., TN (USA). [1987]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Separation technology; Schloss Elmau (Germany, F.R.); 26 Apr - 1 may 1987. Order Number DE91009650. Source: OSTI; NTIS; GPO Dep.

A new type of adsorbent material has been developed in which very small adsorbent particles are entrapped in a hydrocolloidal gel matrix that is formed into small, monodisperse spherical beads. Examples of applications of this type of material include dispersed, hydrous transition metal oxides that can be used for the retention of biocatalysts, such as enzymes, and certain microorganisms or microbial fragments that can be dispersed into the gel matrix to accumulate and isolate various dissolved metals. 7 refs., 2 figs., 2 tabs.

12946 (CONF-9004182–4) **Thermal reclamation of spent blasting abrasive.** Bryan, B.G. (Institute of Gas Technology, Chicago, IL (USA)); Thomas, W.; Adema, C. Institute of Gas Technology, Chicago, IL (USA). [1990]. 7p. Sponsored by Ins. From 17. environmental symposium of the American defense preparedness association: environmental compliance and enforcement at DOD installations in the 1990's; Atlanta, GA (USA); 17-20 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

Abrasive blasting media is used to remove anticorrosive and antifoulant coatings from the hulls and tanks of US Navy ships. The total production of paint-contaminated spent abrasives from the eight US. Navy shipyards ranges from 75,000 to 100,000 tons per year. Most of this spent abrasive is disposed in landfills. Organic paint binders and heavy metals are present in the spent abrasives in concentrations sufficient to classify them as hazardous wastes in some states. In an effort to avoid the rising costs an long-term environmental liability associated with landfilling this waste, the US Navy has investigated various methods of reclaiming spent abrasives for reuse in hull- and tank-blasting operations. This paper discusses the results of a research and development project conducted under the Navy's Hazardous Waste Minimization Program to test a fluidized-bed sloped-grid (FBSG) reclaimer to determine if it could be used to recycle spent abrasive. Thirty tons of abrasive were processed and a product meeting military specifications for new abrasives was reclaimed. Blasting performance was also comparable to new abrasives. 3 refs., 1 fig., 2 tabs.

12947 (CONF-9006119–1) **Bioremediation of gas industry wastes: Current status and new directions.** Gauger, W.K.; Srivastava, V.J. Institute of Gas Technology, Chicago, IL (USA). [1990]. 33p. Sponsored by Ins. Contract 5086-260-1465. From Hazardous waste and environmental management in the gas industry; Chicago, IL (USA); 11-13 Jun 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

Environmental issues of concern to the gas industry include the cleanup of hazardous wastes. The types of pollutants include polychlorinated biphenyls, polyaromatic hydrocarbons, aliphatic hydrocarbons, and heavy metals. Some of these pollutants are present in gas transmission systems and others at existing facilities or abandoned manufactured gas plants. Although most applicable to sites laden with organic pollutants, bioremediation may also be useful in metals clean-up. Factors that most influence the success of bioremediation include contaminant concentration, contaminant type, and contaminant bioavailability. Pollutant bioavailability may be the most important factor to consider when selecting bioremediation options. Fundamental understanding of biological processes has increased the rates and extent of waste degradation. Economically acceptable bioremediation options have been devised and implemented for liquids, solids slurries, and intact soils. Future directions include combining physical and chemical processes with biological treatment under aerobic and anaerobic conditions as well as using genetic engineering to achieve site remediation. 16 refs., 9 figs., 3 tabs.

12948 (DOE/CE–040762T-H1) **Assessment of thermal swing absorption alternatives for producing oxygen enriched combustion air.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of Industrial Programs. Apr 1990. 64p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008240. Source: OSTI; NTIS; GPO Dep.

It has been established that oxygen enriched combustion (OEC) can substantially improve the thermal efficiency and productivity of a furnace. An OEC performance study by the Union Carbide Corporation found that in furnaces with flue gas temperatures above 2,000°F, a high level of oxygen (O_2) enrichment (50% to 100% O_2) will result in a 40% to 60% fuel savings. The US DOE's (Department of Energy) Office of Industrial Programs (OIP) has sponsored several research development projects and engineering assessments relevant to the production of oxygen enriched air (OEA) and its use in combustion systems. In an OIP-sponsored assessment of research and development opportunities for combustion technologies, Taratec Corporation indicated that thermal swing absorption (TSA) offers a potentially viable option for producing low-cost oxygen enriched combustion air (OECA). In fact, an integrated, TSA-based oxygen enriched air production system driven by waste heat from furnace exhaust may be more energy- and cost-efficient than the alternative technologies. The study presented in this document further investigates and assesses TSA alternatives for producing low-cost OECA. 7 refs., 4 figs., 5 tabs.

12949 (ETDE-IT–90-91) **Cogeneration in Italy: Commercialization feasibility study.** ENEA. Rome (Italy). Aug 1989. 154p. (In Italian). Order Number DE91744333. Source: OSTI; NTIS (US Sales Only).

Within the framework of Italian national energy planning to the year 2000 (stressing energy conservation and environmental protection), the commercialization feasibility of cogeneration plants is assessed. Cost/benefit and emissions aspects are examined for present and future plants, using internal combustion engines (diesel or Otto cycle), gas and steam turbines. The evaluation of commercialization potential focuses on an analysis of the effectiveness of the ENEL (Italian National Electricity Board) rate structure, legal incentives established by the Government to promote energy conservation, and feasible applications in Italy - district heating, process heat, etc. A survey is made of Italian research organizations involved in cogeneration development and comparisons are made with the commercialization effort of other Common Market countries.

12950 (ETDE-mf–1754846) **Dual-purpose power plants. Examples of existing plants.** Arbeitsgemeinschaft fuer Sparsamen und Umweltfreundlichen Energieverbrauch e.V. (ASUE). Frankfurt am Main (Germany, F.R.). [1990] 30p. (In German). Order Number DE91754846. Source: OSTI; NTIS (US Sales Only).

In this booklet of the Working Group for Economical and Ecological Energy Consumption, study group dual-purpose power plants, 13 cogeneration plants are presented. Apart from a short description of the estates to be supplied technical data is given in a table.

Finally operating data is listed so that a comparative evaluation of the plants is possible. (BWI).

12951 (ETSU-B–1238) **The private sector waste contracting industry in Britain. Part 1: Profile and structure; Part 2: The future for energy-from-waste technologies within the private waste contracting industry.** Energy Technology Support Unit, Harwell (UK). 1990. 144p. Order Number DE91750295. Source: OSTI; NTIS (US Sales Only).

This report estimates the size of the non-hazardous industrial and commercial solid waste market in Great Britain, and describes the structure of the private sector waste contracting industry that is responsible for much of the collection and disposal of these wastes. The total value of the British market is estimated to be pound535 millions per annum, of which the private sector market share is $400 millions (75 per cent), with the remaining pound135 millions representing the local authorities' market share. The market has two major constituent parts: waste collection and waste disposal. The waste disposal market is estimated to have a total value of pound178 millions per annum, of which the private sector is pound115 millions, or 64 per cent. Waste collection is estimated to have a value of pound350 millions per annum, the private sector share being pound280 millions or 80 per cent. (author).

12952 (EUR–12695) **High temperature industrial heat pumps: Final report.** Berghmans, J. (Louvain Univ., Heverlee (Belgium). Inst. Mechanica). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Louvain Univ., Heverlee (Belgium). Inst. Mechanica. 1990. 133p. Sponsored by Com. Contract EN3E-0127-B. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The present report intends to describe the state of the art of high temperature industrial heat pumps. A description is given of present systems on the market. In addition the research and development efforts on this subject are described. Compression (open as well as closed cycle) systems, as well as absorption heat pumps (including transformers), are considered. This state of the art description is based upon literature studies performed by a team of researchers from the Katholieke Universiteit Leuven, Belgium. The research team also analysed the economics of heat pumps of different types under the present economic conditions. The heat pumps are compared with conventional heating systems. This analysis was performed in order to evaluate the present condition of the heat pump in the European industry.

12953 (GB–282) **Infra-red curing in vehicle refinishing: A demonstration at Peugeot Talbot [Coventry].** Department of Energy, London (UK). Energy Efficiency Office. Aug 1990 26p. (EEO-NP–14). Order Number DE91752819. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

Installation of an infra-red stoving oven at Peugeot Talbot has resulted in energy savings, manpower savings; savings on materials; improvements in quality; savings in floor space and the elimination of a major bottleneck constraining production. Financial savings due to the project were Pound 332,000/year, excluding the savings due to the quality improvements, the saving in floor space and elimination of the bottleneck. When compared with the capital cost of Pound 272,000, this figure gives a payback period of 10 months. Energy savings are approximately 30,300 GJ/year, worth approximately Pound 93,000/year. The payback period based on energy cost savings alone is three year. These figures are based on predictions made by Peugeot Talbot's management, and the monitoring carried out during this project suggests that the actual savings are greater than those predicted (Pound 325,600/year plus other benefits). The energy cost per car was reduced from Pound 1.70/car to 27p/car with the infra-red oven. (author).

12954 (GB–283) **A retrofit combined cycle CHP scheme [final report]: A demonstration at Purfleet Board Mills, Purfleet, Essex.** Department of Energy, London (UK). Energy Efficiency Office: Thermal Developments Ltd., Sedgefield (UK). Jul 1990 87p. (EEO-NP–7). Order Number DE91752820. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

The combined cycle gas-turbine/steam-turbine CHP system installed at the Purfleet Board Mills in the UK has been in beneficial operation since December 1987. It provides almost all the electrical power requirements of the mill and the whole of the process steam demand, saving almost Pound 1 million/year. The total cost of the project was Pound 2.7 million. On the basis of 8,400 operating hours, the annual cost saving amounts to Pound 970,000 compared with the original steam turbines CHP system operated by PBM. This represents a 25% reduction in energy costs and gives the project a simple payback period of 2.8 years. The combined-cycle CHP plant is based on a gas turbine generating approximately 3.5 MWe. The hot exhaust gases from the gas turbine are ducted to an existing high pressure water-tube boiler, modified to use the exhaust as combustion air. Steam from the boiler at 600 psig is let down through a new back-pressure pass-out steam turbine, generating up to 7.7 MWe. In addition to the combined-cycle concept operating in parallel with the grid, novel aspects of this project include the use of either natural gas or landfill gas (LFG) as the primary gas turbine fuel, and the conversion of the water-tube boiler to accept the gas-turbine exhaust while retaining the capability of burning natural gas, LFG or heavy fuel oil on its existing burners. (author).

12955 (GB–284) **Improved temperature distribution in a tunnel kiln: A demonstration at Yorkshire Brick Co. [Barnsley].** Department of Energy, London (UK). Energy Efficiency Office; British Ceramic Research Ltd., Stoke-on-Trent (UK). Oct 1990 31p. (EEO-NP–17). Order Number DE91756933. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

Yorkshire Brick Company has demonstrated successfully how the temperature distribution in a tunnel kiln can be improved, with the benefits of better energy efficiency and increased output. This was achieved principally through a redistribution of hot air within the kiln, installation of extra burners and closely controlled cooling. The main projected benefits following the modifications were realised in full, with the specific fuel requirement reduced by 25% and output increased by 34%. If the kiln was operated at the same level of output as before the modifications, the fuel consumption was reduced by 11% giving an annual fuel saving of 96,000 therms (10,000 GJ). The firing time (heating and cooling) was reduced from 54h to 40h and product quality was maintained. Against a capital cost of Pound 265,000 the annual cost benefits were about Pound 243,000 giving a simple pay-back period of 1.1 years. The success of the project is reflected in the fact that within six months of the kiln modifications the Company carried out duplicate modifications to their other tunnel kiln. If the technology penetrated 25% of tunnel kiln plants in the industry, it is estimated, based on 1987/88 energy returns, that the reduction in specific energy requirements would represent energy savings of about 5.5M therms/year (0.6MGJ/year). At a price of 30p/therm for natural gas, this would be worth about Pound 1.7M. (author).

12956 (GB–285) **Heat recovery from plastic injection moulding machines: A demonstration at Silleck Mouldings Ltd. [Glasgow].** Department of Energy, London (UK). Energy Efficiency Office. Feb 1990 23p. (EEO-NP–5). Order Number DE91756934. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

Substantial energy savings are being achieved by Silleck Mouldings Limited at its plastics mouldings factory at Inchinnan, Scotland. A new system has been installed which recovers waste heat from the production processes and uses this for building space heating, whilst also reducing the electricity demand for chilling and water recirculation. The installation, which cost Pound 11,000, generates annual savings of approximately Pound 21,300 giving a payback period of just over six months. Subsequent expenditure on the plant has indicated that a total capital cost of Pound 13,500 should be taken for future reference, against the same annual savings figure;

this gives a payback period of eight months. The project was carried out to demonstrate a new application for plate heat exchanger technology as a part of the plastics moulding process. Independent monitoring commenced when the equipment was installed in October 1987. No major problems have been experienced and savings of Pound 21,300/year have been achieved. (author).

12957 (GB–286) **A gas turbine based combined cycle CHP scheme: A demonstration at Rigid Paper Products Ltd., Selby, North Yorkshire.** Department of Energy, London (UK). Energy Efficiency Office; Thermal Developments Ltd., Sedgefield (UK). Mar 1990 86p. (EEO-NP–4). Order Number DE91752821. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

The gas turbine CHP system installed at Rigid Paper Products paper and board mill at Selby, North Yorkshire, has been in beneficial operation since September 1986. It generates electrical power in excess of the mill requirements and supplies all process steam, saving approximately Pound 600,000/year. The installed cost of the project was Pound 1,716,000. Based on 7,600 operating hours per year, the net annual cost saving is Pound 587,000 compared with the original situation of purchased electrical power and steam generation using gas fired boilers. This represents a 45% reduction in energy costs and gives the project a simple payback period of 2.9 years. The main features of the scheme are: the use of a gas-turbine-powered generating set to meet the electrical power requirements of the mill and provide surplus power for sale to the Yorkshire Electricity Board; the use of the gas turbine's high temperature exhaust, with the aid of supplementary fuel, to produce enough steam to meet the total mill steam load. (author).

12958 (GB–287) **Installation of two energy efficient tumble dryers in a commercial laundry: A demonstration at Bourne Services Ltd. [Bourne, Lincolnshire].** Department of Energy, London (UK). Energy Efficiency Office; Fabric Care Research Association, Harrogate (UK). Mar 1990 33p. (EEO-NP–3). Order Number DE91756935. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

Total energy savings worth approximately Pound 2,200/year have been achieved by the installation of two Milnor axial-flow gas fired tumble dryers at Bourne (Laundry) Services Ltd in Lincolnshire (UK). Potential energy-saving features include a novel air-flow path, variable air-flow rates, a reduced electrical load and automatic detection for fully dried work. They are controllable for inlet and outlet temperatures, air-flow rates, drying time, cooldown time and tumbling action. A comparison of the performance of the Milnor machines with that of conventional tumble dryers revealed that, in terms of moisture-removal rate, gas consumption per unit of moisture removed and cycle time, they performed no better than conventional equipment. No energy savings could be attributed to the dryers' novel air-flow path and variable air-flow cycle. Savings in gas consumption did, however, result from automatic detection of the drying cycle end point for fully dried work. For the two dryers this was estimated to be 140 GJ/year, worth Pound 404/year. Electrical energy savings were worth Pound 1,792/year. The additional cost of the Milnor machines was Pound 550 at the time of purchase, and the total energy cost saving of Pound 2,196/year gives a simple payback period of just three months. (author).

12959 (GB–289) **Generation of electricity using spark ignition engines fuelled by landfill gas: A demonstration at Shanks and McEwan Ltd. [Milton Keynes].** Department of Energy, London (UK). Energy Efficiency Office; Ewbank Preece Ltd., Brighton (UK). Oct 1990 52p. (EEO-NP–19). Order Number DE91756937. Source: OSTI; NTIS (US Sales Only).

New Practice Report from the Energy Efficiency Best Practice Programme for the Energy Technology Support Unit, Harwell (GB).

This report covers the first 32 months operation of three 275 kW spark ignition reciprocating engines fuelled by landfill gas. Electricity generated by the three engines over the 32 months was 17,600,000 kWh which resulted in energy savings to the nation of some 74,000 GJ/year on a prime fuel basis. Overall service factors and capacity factors were 95% and 91% respectively, and the average running load was 266 kW. Exhaust emission tests showed high carbon monoxide levels, indicating carburation problems, but low NOx levels compared with the expected emissions from the same type of engine fuelled by natural gas. Although the noise was unpleasant within the engine house, outside, at a distance of 50 metres, it was inaudible above the background noise and unlikely to be heard outside the site perimeter at any time of day. The report includes a financial analysis of the project based on running to date, and this shows a simple payback period of 2.4 years. (author).

12960 (GB–291) **Energy efficient furnace technology and operation.** Dixon, John (British Steel Corp., Rotherham (UK). Swinden Labs.). Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Jun 1985 28p. (G–58/85). Order Number DE91752778. Source: OSTI; NTIS (US Sales Only).

An article based on a series of lectures is presented. They concern the design of furnaces for use in reheating and heat treatment in the metal industry to achieve maximum energy efficiency. The elements of the energy balance of the furnace and various options for waste heat recovery are discussed. (UK).

12961 (GB–292) **Recovery of waste heat in the glass industry.** Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Aug 1986 49p. (ED–89). Order Number DE91750263. Source: OSTI; NTIS (US Sales Only).

After outlining the scope for recovery of waste heat in the glass industry, summaries of five projects which have been undertaken with the support of the Energy Efficiency Demonstration Scheme are presented. These describe recuperation heat recovery units on glass furnace working ends; recovery of waste heat above a working end using a run-around coil; waste heat recovery for space heating in glass container manufacturing; and recovery of waste heat from a lehr at a float glass works. The overall energy savings for each project are presented. (author).

12962 (GB–293) **Recuperative burners for metal melting, heat treatment and reheating furnaces.** Ford, Eric (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Aug 1985 29p. (S–59/85). Order Number DE91750264. Source: OSTI; NTIS (US Sales Only).

This document examines the role of recuperation in waste heat recovery and details the main characteristics and results of six demonstration projects partly funded and independently monitored under the Energy Efficiency Office's Energy Efficiency Demonstration Scheme. Both remote and self-recuperation are examined, and the furnaces include those used for metal melting, reheating or heat treatment. In each of the demonstrations examined, the main novel aspect was the installation of a particular type of recuperative burner and its mode of use. In several instances, the demonstrations took advantage of the modifications to improve furnace linings and reduce the amount of heat and therefore energy lost through the casing. In one early demonstration, the waste gases rejected by the recuperator were used to raise steam for a space heating system. Energy savings achieved in the six projects were dependent upon the furnace operating temperature, the furnace type, degree of utilisation and method of operation, but were generally of the order of 25% or more. In one instance, the saving was as high as 55%. Payback periods varied from under one year to just over three years. (author).

12963 (GB–294) **A guide to investment appraisal of energy efficiency projects in the steel industry.** Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Mar 1987 98p. (ED–94). Order Number DE91750265. Source: OSTI; NTIS (US Sales Only).

In discussions with management throughout the steel industry and with equipment suppliers, it became evident that a number of worthwhile energy efficient projects were being lost or delayed due to poorly prepared investment cases. This manual has therefore been compiled to give some basic guidelines on how to appraise investment proposals and present the conclusions in a clear and logical form. It illustrates the need for analysing the long-term value

of the project within the declared company strategy and the importance of risk appraisal in presenting the case. The advice given is largely based on the experiences of four senior executives in the steel industry and a well-known financial consultant. The main points discussed in the first part of the manual are illustrated in the second part through the use of six actual projects currently active in both the public and private steel sectors. (author).

12964 (GB–296) **Utilisation of hot pulverised fuel ash in the manufacture of lightweight aggregate building blocks: A demonstration with Granulite (Holdings) Limited.** UKAEA Harwell Lab. (UK). Engineering Science Div.; Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Jun 1989 23p. (ED–253-236). Order Number DE91750267. Source: OSTI; NTIS (US Sales Only).

A new process for manufacturing lightweight aggregate operated by Granulite (Holdings) Limited has been shown to use only 5% of the energy consumed in alternative methods of production. At a production rate of 100,000 te/year this represents an annual cost saving of pound140,000 (95,000 GJ). The capital cost of the Granulite lightweight aggregate plant at present (1989) prices is $1.4M (pound2M with a screening plant included). This is less than half the estimated cost of a new conventional plant. Therefore, the Granulite plant is less expensive in capital terms and considerably cheaper in operating energy costs. The Granulite process uses pulverised fuel ash (PFA) and lime to produce the aggregate for the Granulite 234 lightweight block. Heat recovered from the PFA, chemical reactions and mechanical blowers supply the bulk of the process energy requirements. The Granulite plant has operated successfully for over a year producing lightweight aggregate to the desired specification. The plant is presently capable of producing 100,000 te/year. However, a target of 125,000 te/year for the end of 1989 is considerable reasonable. (author).

12965 (GB–297) **Monitoring of cold road recycling process: A demonstration with Kent County Council.** Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Jul 1989 33p. (ED–230/343). Order Number DE91752779. Source: OSTI; NTIS (US Sales Only).

This report evaluates a new process which was used to repair Lunedale Road, a lightly trafficked residential road in Dartford, Kent. The reconstruction technique consists of cold road recycling with a foamed bitumen bound roadbase. The foamed bitumen process costs 20-25% less and the repair contract was completed 30% more quickly than would have been the case using conventional materials and techniques. Specialist road tests confirmed that the general quality of the road structure and surface compared satisfactorily with that of the control sections reconstructed in conventional bituminous materials. Tests also showed that the reconstructed road should not require structural maintenance within the next 20 years. The recycling process eliminates the need to quarry new stone, dry and coat it with bitumen at 170°C to produce asphalt and transport material to and from site. However, transport costs are very dependent on the distances involved and so the expression of the Energy Cost Savings = Pound 2.06/tonne + Pound 0.007/tonne.km. For a typical project involving 100 km return journeys this gives cost savings of Pound 3.46/tonne, which, for Lunedale Road, corresponds to Pound 1.31 /m^2. (author).

12966 (GB–298) **Automatic remote monitoring and control of coal-fired boiler plant in schools: A demonstration in Staffordshire County Council schools.** National Industrial Fuel Efficiency Services Ltd., Altrincham (UK); Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Jan 1987 58p. (ED–111/64). Order Number DE91750268. Source: OSTI; NTIS (US Sales Only).

After limited success with conventional controls, Staffordshire County Council (SCC) has installed an electronic energy management system (EMS) to provide centralised monitoring and control of coal-fired plant in schools. Following a initial pilot scheme in three schools, SCC installed a Transmitton Micropower 2000 Series system in 21 schools. Intelligent outstations in each school are connected to a single central station at the council offices in Stafford using the public telephone network. This allows boiler plant and heating systems to be monitored and controlled from Stafford, including operational control of boiler plant, day-to-day programming and monitoring of plant status and fault conditions. The project has proved that monitoring and control of coal-fired installations can be successfully achieved by a distributed energy management system with increased savings over conventional controls. In this instance an average overall reduction of 12.9% in coal consumption at the 21 schools was achieved thereby yielding an energy cost saving of pound41,576. With a capital cost of pound158,341 this gives an anticipated return on investment of 3.8 years. (author).

12967 (GB–299) **The use of stenter exhaust filtration and recirculation in textile finishing: A demonstration at Wrights and Dobson Ltd.** Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK). Sep 1988 30p. (ED–221/310). Order Number DE91750269. Source: OSTI; NTIS (US Sales Only).

Annual energy savings of 2,900 GJ worth approximately pound13,400/year are currently being realised by Wrights and Dobson at its dyeing and finishing factory in Nottingham. Textile setting operations carried out on stenters produce considerable quantities of fumes which are generally exhausted to the atmosphere. These fumes can be eliminated or ameliorated by filtration which, when combined with recycling of the exhaust, can also save energy. The project cost pound8,400 and showed that the principles of filtration and recycling worked well. The filtration system removed 95% of the hydrocarbons and 80% of the particulates, thereby substantially reducing the environmental problem. The recirculation system produced energy savings valued at pound2,600/year. In addition, savings were achieved from two other sources: a reduction in stenter extract rate, giving gas savings worth pound5,300/year; and a reductions in the speed of the internal circulation fans, giving electricity savings valued at pound5,500/year. The total project savings were thus pound13,400/year. After allowing for filter replacement costs of pound2,700/year, the net savings were pound0/year, giving a payback period of 10 months. (author).

12968 (GB–300) **Energy-efficient design of a new hospital laundry: A demonstration at the Swindon Central Laundry of the Wessex Regional Health Authority.** Department of Energy, London (UK). Energy Efficiency Office; National Engineering Lab., East Kilbride (UK); Energy Technology Support Unit, Harwell (UK). Sep 1988 62p. (ED–125/159). Order Number DE91750270. Source: OSTI; NTIS (US Sales Only).

This report details savings arising from the operation of an efficient "low energy" laundry at Swindon. The majority of hot waste water from the washers installed on site is passed through a shell and tube heat exchanger: fresh cold water flows in the opposite direction through the exchanger and the resulting pre-heated warm water forms the main supply to the wash house and to the hot water generation system. Warm water is supplied directly to the two batch continuous tunnel washers: the remainder is further heated in a condensate return heat recovery unit and then raised to the required hot water temperature of 60°C using mainly flash steam plus a small amount of mains steam. The hot water is distributed to the barrier washers. In many of the washing and rinsing procedures, therefore, pre-heated water is used in place of water at ambient temperature. Savings over an equivalent "control" laundry amounted to some pound28,400 (net) in the first year of operation, rising to pound43,550/year after two years. At this latter rate of return, the original incremental investment would have been realised in 2.8 years. (author).

12969 (GB–301) **Energy and cost savings from the installation of a high consistency pulper.** Department of Energy, London (UK). Energy Efficiency Office; Energy Technology Support Unit, Harwell (UK); Robert Gordon's Inst. of Tech., Aberdeen (UK). Jul 1989 23p. (ED–262/218). Order Number DE91750271. Source: OSTI; NTIS (US Sales Only).

In 1986 Thomas Tait and Sons commissioned a new, high capacity paper machine - PM4. As part of the associated pulp preparation plant a new type of high consistency pulper was installed. A single pulper supplies the total slushed pulp requirement for the paper machine which has a design rating of 325 te/day. The installed cost of the pulper was pound121,300. Cost savings worth pound123,000/year gives the project a simple return on investment of slightly less than one year. The savings achieved arise in two principal areas. Energy consumption is significantly lower

when comparing the operation of the high consistency pulper with the industry standard for low consistency pulping. The value of this reduction in energy consumption is pound63,000/year. Labour costs have also been reduced by pound60,000/year. A minimum crewing requirement arises from the single pulper operation with less complicated bale handling conveyors compared with multiple low consistency pulpers required for the same throughput. The energy savings obtained exceeded expectation and amount to between 60% and 65% compared with the industry standard of 60 kWh/te slushed. (author).

12970 (GB–303) **Cost reductions on a titanium dioxide plant identified by a process integration study at Tioxide UK Ltd.** Department of Energy, London (UK). Energy Efficiency Office. Aug 1985 31p. (RD–6). Order Number DE91750296. Source: OSTI; NTIS (US Sales Only).

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the most appropriate investment strategy which will realise the maximum energy cost savings consistent with a particular company's financial and operating criteria. The process integration method involves the rigorous application of thermodynamics and cost accounting, tempered by practical plant engineering and operability considerations. Tioxide UK Ltd is part of Tioxide Group plc and operates two UK sites for the production of titanium dioxide pigment. The site in question, Greatham works near Hartlepool, produces pigment via the chloride route. The energy costs at Greatham works can amount to pound5 - 6 million/year depending on production levels. (author).

12971 (GB–304) **Cost reductions on a synthetic resins site identified by a process integration study at Cray Valley Products Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Aug 1986 39p. (RD–13). Order Number DE91752780. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. The British-led development of Pinch Technology provides a systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. Over the last few years, the application of this technology has led to significant practical savings worldwide on a variety of process plants, both continuous and batch. Cray Valley Products Ltd is part of Coates Brothers plc and is engaged in manufacturing a wide range of synthetic resin intermediates for the ink and surface coatings industries. Process integration was applied to the company's works at Machen, Gwent. The total energy bill of this steadily expanding site is currently around Pound 1 million/year. (author).

12972 (GB–305) **Cost reductions on a man-made fibre plant identified by a process integration study at Courtaulds Fibres Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Oct 1987 43p. (RD–21/28). Order Number DE91752781. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Energy and Process Integration (EPI), Harwell Laboratory.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and identify the minimum cost schemes that maximise savings consistent with planning and operating criteria. The British-led development of Pinch Technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting while taking practical engineering and operability constraints into consideration. Over the last few years, the application of this technology has led to significant practical savings worldwide on a variety of process plants (both continuous and batch). The process integration study encompassed the entire site, including the sulphuric acid plant and power plant. The aim was to establish the minimum practical energy requirements, and to develop an investment strategy to minimise plant energy consumption in a cost-effective manner. (author).

12973 (GB–306) **Cost reductions in a creamery identified by a process integration study at Express Foods Group.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Sep 1987 47p. (RD–22/29). Order Number DE91752782. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purposes of a process integration study are to determine the minimum practical amount of energy required to operate a process and to identify the minimum-cost schemes that maximise savings consistent with planning and operating criteria. The British-led development of pinch technology provides a systematic approach. It involves the rigorous application of thermodynamic principles and cost accounting while taking practical engineering and operability constraints into consideration. In recent years the application of this technology has led to significant practical savings world-wide on a variety of process plants (both continuous and batch). Process integration was applied to all the major processes and utility systems at a creamery. The aim was to establish the minimum practical energy requirements, and to develop an investment strategy to minimize plant energy consumption in the most cost-effective manner. (author).

12974 (GB–308) **Cost reductions on an edible oil refinery identified by a process integration study at Van den Berghs and Jurgens Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Oct 1986 37p. (RD–14). Order Number DE91752784. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process; and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. Given the complexity of many industrial processes, this objective has often been pursued by trail and error. The British-led development of pinch technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. The process integration study at the Bromborough edible oil refinery was undertaken with the help of Linhoff-March Consultants. It cost around Pound 36,000 and was completed in six months. The study established that the process heat consumption of the refinery and hardening plant could be reduced by 80% if the plant was fully integrated. (author).

12975 (GB–309) **Cost reductions on a brewery identified by a process integration study at Tetley Walker Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Aug 1986 39p. (RD–11). Order Number DE91752785. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. The British-led development of Pinch Technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. Process integration was applied to Tetley Walker's brewery at Warrington. The total energy bill of the site at the time the study was undertaken was in the region of Pound 850,000,divided fairly equally between fuel and electricity. The study established that the practical minimum amount of fossil fuel needed to operate the site was 76% of the current consumption. Several opportunities for cost effective energy conservation were identified, some interacting, others independent of each other. Three investment strategies were developed which involve the implementation of packages of compatible energy saving opportunities. (author).

12976 (GB–310) **Cost reductions on a food processing plant identified by a process integration study at Cadbury Typhoo Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Aug 1986 37p. (RD–12). Order Number DE91752786. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. The British-led development of Pinch Technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. Cadbury Typhoo Ltd is part of the Cadbury Schweppes Group. The company produces and markets hot and cold beverage products. A process integration study was carried out at the company's Knighton manufacturing site where 'instant' powder beverage ingredients are made and packaged. The total energy bill at the site is in the region of Pound 0.5 million/year. The process energy bill is around Pound 300-350,000/year. The first significant opportunity involves changing the actual process by a different piping arrangement. For a capital expenditure of around Pound 1,000, savings worth Pound 25.000/year can be achieved with a payback of approximately two weeks. (author).

12977 (GB–311) **Cost reductions on a food processing site identified by a process integration study at J Lyons and Co. Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Jul 1987 59p. (RD–20/27). Order Number DE91752787. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes which will maximise savings consistent with planning and operating criteria. The British-led development of pinch technology provides a systematic approach for process integration. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. Over the last few years the application of this technology has led to significant practical savings world-wide on a variety of process plants. The J Lyons Group operates a 78-acre industrial estate at Greenford, Middlesex. The estate accommodates three substantial food processing companies and a number of smaller operations involved in food processing, distribution and other activities. At the time the study was carried out, the total site energy bill amounted to around Pound 3.5 million/year, of which electricity represented some 44%. The Lyons Group were concerned about the size of the site energy bill and had already introduced a variety of energy saving measures within the individual operating companies which had reduced energy consumption by as much as 30% in certain areas. (author).

12978 (GB–312) **Cost reductions on a processed foods plant identified by a process integration study at Batchelors Foods Ltd.** Clayton, R.W. (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK). Energy Efficiency Office. Jan 1989 34p. (RD–47/61). Order Number DE91752788. Source: OSTI; NTIS (US Sales Only).

Original report prepared by Linnhoff-March Consultants Ltd.

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the most appropriate investment strategy for realising maximum energy cost savings consistent with a particular company's financial criteria. The British-led development of process integration provides a more systematic approach. Process integration involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. Over the last few years the application of this technology has led to significant practical savings world-wide on a variety of process plants: both continuous and batch. The aim of the process integration study was to establish the scope for cost-effective energy savings. Targets for saving were set to provide a payback period of less than two years. The need to allow for future expansion and change represented an added constraint on design. (author).

12979 (GB–317) **Combined heat and power in a grain whisky distillery: A demonstration at Scottish Grain Distillers Ltd [Glasgow].** Department of Energy, London (UK). Energy Efficiency Office; Thermal Developments Ltd., Sedgefield (UK). Mar 1989 48p. (EEO-ED–245/208). Order Number DE91752794. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The gas turbine based CHP system installed at Scottish Grain Distillers' Port Dundas distillery in Glasgow has been in beneficial operation since September 1985. It provides a surplus of electrical power and a supply of high grade energy in its exhaust gas, used directly in a dryer associated with the by-product animal feed plant, as well as for process steam generation. The project has demonstrated that a gas turbine can be used to supply a large quantity of high grade heat to process equipment normally requiring direct firing, whilst providing a reliable power supply meeting the requirements of the site, with a surplus available for export to the grid. While the particular set of circumstances at Port Dundas are unlikely to be encountered outside the distilling industry, opportunities exist for energy savings through gas turbine-based CHP installations in any continuous process industry where the site electrical load exceeds 2 MW and a suitable heat load of over 150 therms/hour exists in the form of direct process heating and/or steam generation (about 7 tonnes/hour). For sites burning gas or oil and in continuous production the payback priod can range from 2.5 to 4.5 years. (author).

12980 (GB–318) **Waste heat recovery at two different stages in a furnace exhaust path: A demonstration at IMI Yorkshire Imperial Ltd., Kirkby Works.** Department of Energy, London (UK). Energy Efficiency Office; BNF Metals Technology Centre, Wantage (UK). Jul 1987 50p. (EEO-ED–122/53). Order Number DE91752793. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Savings of over Pound 90,000/year resulted from the installation of two waste heat recovery systems at IMI Yorkshire Imperial Ltd's Kirkby works in the U.K. The Kirkby works produces copper tubing for the domestic water and heating market. The tubing is extruded from continuously cast billet, and the metal for the casting process, comprising scrap, blister and cathode copper, is melted in six open-flame Sklenar furnaces, each of 10-tonne capacity. After consideration of both furnace design and operational procedures, IMI decided to recover some of the heat from the exhaust gases at two different stages in the exhaust path. An innovatory gas-to-air heat pipe heat exchanger was installed in the exhaust of one of the furnaces; this was a purpose-built system incorporating a Q-dot heat exchanger. The heat recovered was fed back to the furnace burners as pre-heated combustion air. The second installation comprised a gas-to-water heat exchanger in the main exhaust duct serving all six furnaces: the heat recovered pre-heated the return water to the boiler house which provided water, space and process heating throughout the site. (author).

12981 (GB–319) **The silent dryer drive ™: A demonstration project at Henry Cooke Ltd., Cumbria.** Nuttall, G.H. Department of Energy, London (UK). Energy Efficiency Office. Jul 1989 30p. (EEO-ED–260/341). Order Number DE91752791. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The Silent Dryer drive dispenses with the usual train of gears familiar in paper machine drying sections and drives the section through a number of small motors on individual felt rolls. The first UK installation at the Henry Cooke mill has been completed by Beloit Walmsley and is highly successful: the drive is cheaper, very much quieter, saves energy and maintenance costs and gives a better moisture profile at the reel-up. Payback is potentially high especially if advantage can be taken of the smoothness of the drive to increase production. The Henry Cooke installation was on

the pre-dryer section of an MG machine running at speeds up to 440 m/min and was carried out to remove the production bottleneck caused by frequent breaks, speed restriction due to irregular tension in the web and excessive maintenance of the original dryers. (author).

12982 (GB–320) **Measuring and monitoring energy in textile finishing.** Department of Energy, London (UK). Energy Efficiency Office; Shirley Inst., Manchester (UK). Nov 1988 27p. (EEO-ED–143/47). Order Number DE91752796. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The "Monitoring and Targeting" (M and T) method has already been recognised as a key method of achieving energy cost savings in textile finishing through the experience of a pilot scheme financed by the Department of Energy. This report is aimed at energy managers and designers of textile machinery. It provides a detailed guide to the use of simple techniques for measuring and monitoring energy consumption in individual heat-using textile finishing machines (ranges, dyeing machines, washers, stenters, bakers, setters, singeing machines) and applying "Monitoring and Targeting" at the machine level. (author).

12983 (GB–324) **Cost reductions at a steel works: Identified by a process integration study at Sheerness Steel plc.** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Aug 1987 43p. (EEO-RD–18/25). Order Number DE91752804. Source: OSTI; NTIS (US Sales Only).

The purposes of a process integration study are to: determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. The British-led development of Pinch Technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting whilst taking account of practical engineering and operability constraints. The Sheerness Steel Company is part of the international Co-Steel Group of Companies, specialising in the production of merchant steel bar and rod products from scrap which has been remelted and refined in an arc furnace. The process integration study encompassed the more energy intensive parts of the site; the arc furnace melting and refining operations and the reheat furnaces. Although the site operates 24 hours/day 7 days/week, the arc furnace is a batch process and the bar and rod mills operate to meet product demand. (author).

12984 (GB–325) **Cost reductions on an integrated steel plant: Identified by a process integration study at British Steel Corp. [Scunthorpe].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Oct 1988 58p. (EEO-RD–38/40). Order Number DE91752805. Source: OSTI; NTIS (US Sales Only).

The purpose of a process integration study are to determine the minimum practical amount of energy required to operate a process and to identify the minimum-cost schemes that maximise savings in conformity with planning and operating criteria. The British-led development of pinch technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting while taking practical engineering and operability constraints into consideration. The Scunthorpe integrated steel works is one of five operated by the British Steel Corporation (BSC). It is used to convert iron ore and recycled scrap into semi-finished steel products. The site has the capacity to produce some three million tonnes of steel/year. The study showed that, in theory, the site demand for process heat could be reduced by around 11%. The study identified over 20 energy efficiency opportunities, within the major processing plants, with potential cash benefits between Pound 350,000 and Pound 5 million/year. (author).

12985 (GB–326) **Cost reductions at a paper mill: Identified by a process integration study at St Regis Paper Co. (UK) Ltd. [Exeter].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Mar 1987 40p. (EEO-RD–17/16). Order Number DE91752806. Source: OSTI; NTIS (US Sales Only).

The purposes of a process integration study are to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes that maximise savings consistent with planning and operating criteria. The British-led development of pinch technology provides a more systematic approach. This technique involves the rigorous application of thermodynamic principles and cost accounting while taking account of practical engineering and operating constraints. The St Regis Paper Company operate five paper mills in the United Kingdom. The company's fine paper mill at Hele, Exeter, produces a range of speciality papers from imported pulp. The site's capacity is around 40,000 tonnes/year using three paper making machines. Process integration was applied to the energy intensive processes of the plant, to establish the minimum practical energy requirements and to develop an investment strategy that would minimise the plant energy consumption in the most cost-effective manner. (author).

12986 (GB–327) **Cost reductions on a paper mill: Identified by a process integration study at East Lancashire Paper Mill Co. [Manchester].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Jan 1987 38p. (EEO-RD–15). Order Number DE91752807. Source: OSTI; NTIS (US Sales Only).

The purpose of a process integration study is to determine the minimum practical amount of energy required to operate a process and to identify the minimum cost schemes to maximise savings consistent with planning and operating criteria. The British-led development of pinch technology provides a more systematic approach. The East Lancashire Paper Mill Company is part of the British Syphon Group. The company produces a wide range of speciality paper from imported pulp. The capacity for producing 'white' fine paper and 'brown' packaging materials is around 80,000 tonnes/year using five paper-making machines. Process integration was applied to the energy intensive processes of the plant to establish the minimum practical energy requirements and to develop an investment strategy aimed at minimising the plant energy consumption cost effectively, both present production levels, and with future expansion in mind. The study established that the energy intensive parts of the plant could be run at 34% less heating costs than at present. This would be worth Pound 360,000/year. (author).

12987 (GB–328) **Cost reductions on a speciality chemicals plant: Identified by a process integration study at Bush Boake Allen Ltd. [Widnes].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office; UKAEA Harwell Lab. (UK). Engineering Science Div. May 1988 36p. (EEO-RD–33/35). Order Number DE91752808. Source: OSTI; NTIS (US Sales Only).

Bush Boake Allen Ltd is a leading producer of aroma chemicals, flavours and fragrances. These products are made in a wide range of specifications from natural and synthetic precursors by chemical reaction and distillation. The process integration study covered the entire site, whilst concentrating on process energy demands. The purpose of the study was to identify modifications to the plant which could reduce energy related costs while observing strict financial and technical constraints imposed by management. The results of the study indicated that, disregarding constraints, full integration of the plant could reduce the energy related costs by 20%. Opportunities for integration within individual plant units found in most of the plants examined. (author).

12988 (GB–329) **Cost reductions on an oil refinery: Identified by a process integration study at Gulf Oil Refining Ltd. [Milford Haven].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office; UKAEA Harwell Lab. (UK). Engineering Science Div. May 1986 32p. (EEO-RD–7). Order Number DE91752812. Source: OSTI; NTIS (US Sales Only).

Gulf Oil Refining Ltd is a subsidiary company of Chevron Oil Corporation. It operates a single oil refinery in the UK at Milford Haven. Process integration was applied to the 'front end' of this refinery. The study encompassed the crude oil atmospheric and

vacuum distillation units. The objective was to identify the most appropriate investment strategy which would minimise the refinery energy costs in a cost effective way while retaining a high degree of operating flexibility. The study identified investment opportunities which, if implemented, would reduce the energy consumption of this part of the site by around 8% and be worth about Pound 1.1 million/year. (author).

12989 (GB–330) **Cost reductions on a speciality chemicals plant: Identified by a process integration study at William Blythe and Co. Ltd. [Accrington].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Aug 1985 37p. (EEO-RD–5). Order Number DE91752813. Source: OSTI; NTIS (US Sales Only).

This process integration study was carried out at the Hapton works in the United Kingdom of Will Blythe and Co Ltd and applies to the production of a variety of sulphur based chemicals. The study established that, in principle, the site steam demand could be met entirely from waste heat produced from combustion of sulphur thereby eliminating the requirement for fossil fuel. In practice, this would be impossible to achieve and an investment strategy involving four discrete projects was developed. When implemented, the site energy consumption will be reduced by 40%, around Pound 90,000-Pound 100,000/year, with an overall payback period of 11 months. These opportunities are the subject of further engineering studies and implementation is planned for 1985/86. Notable features of the study are the beneficial application of process integration to a relatively small inorganic chemicals site utilising both semi-continuous and batch processes; the steam supply system and the identification of an opportunity for combined heat and power; the rationalisation of the plant operating procedures and consequent benefits in terms of reduced energy costs. (author).

12990 (GB–331) **Cost reductions on a site producing soap and detergents: Identified by a process integration study at Procter and Gamble Ltd. [West Thurrock].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office: UKAEA Harwell Lab. (UK). Engineering Science Div. May 1986 35p. (EEO-RD–8). Order Number DE91752814. Source: OSTI; NTIS (US Sales Only).

The company, which is a subsidiary of the multinational Procter and Gamble Company, manufactures soap and detergent products at two UK sites. A process integration study of the West Thurrock site was undertaken with the help of the Energy and Process Integration Service (EPI). This organisation offers a specialist process integration consultancy service. The study cost around Pound 45,000, including consultancy fees and Procter and Gamble staff time. It was completed in 12 months. The study established that the consumption of process energy could be reduced by around 25% if the site was fully integrated. (author).

12991 (GB–332) **Cost reductions at a solvent recovery plant: Identified by a process integration study at Beecham Pharmaceuticals [Irvine].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Jun 1987 33p. (EEO-RD–16/17). Order Number DE91752815. Source: OSTI; NTIS (US Sales Only).

This process integration study was carried out at the Irvine plant of Beecham Pharmaceuticals in the United Kingdom and relates to the manufacture of antibiotic intermediates by fermentation, solvent extraction and chemical synthesis. The study identified three projects which, taken together, would reduce the heat consumption of the solvent recovery plant by 64%, saving around 50% on energy costs. Beecham is planning to implement two of the three opportunities. These will achieve a 26% reduction in heat consumption worth around Pound 30,000/year. The capital cost is estimated at Pound 10,000-Pound 12,000 which yields a payback period of four to five months. A notable feature of the study is its application to a small scale, continuously operating distillation scheme which already contains an extensive heat recovery system. Such systems are not unique to the pharmaceuticals industry. The experience gained at Beecham is relevant to other companies involved in the production of speciality chemicals, flavours and essences and bulk organic chemicals in addition to the pharmaceutical field. (author).

12992 (GB–333) **Cost reductions on a speciality chemicals plant: Identified by a process integration study at May and Baker Ltd. [London].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. May 1988 39p. (EEO-RD–37). Order Number DE91752816. Source: OSTI; NTIS (US Sales Only).

This process integration study was carried out at a large manufacturing site belonging to May and Baker in the United Kingdom. It relates to the manufacture of a wide range of intermediate and finished pharmaceutical and chemical products. The study concluded that the energy related costs of the site could be reduced by over Pound 1 million/year, giving an overall payback period of around 2.2 years. These savings can be achieved in three different areas. Integration within the more significant energy consuming process could save nearly Pound 111,000/year (at 1986 fuel prices). Decentralisation of the building space heating systems would save some Pound 377,000/year mainly by reducing distribution and standing losses. Finally, the installation of a gas turbine based combined heat and power scheme to meet the process heating demand and to provide the base load electricity demand would save some Pound 588,000/year. A two phase investment strategy was recommended. The first phase would involve implementing the integration opportunities on the individual processes and the decentralisation of building services. This phase would save Pound 488,000/year giving a payback period of 1.8 years. These cash savings could then be used to finance the implementation of the combined heat and power plant. (author).

12993 (GB–334) **Cost reductions for a new speciality chemicals plant design: Identified by a process integration study carried out by May and Baker Technology.** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Nov 1988 52p. (EEO-RD–39/41). Order Number DE91752817. Source: OSTI; NTIS (US Sales Only).

This study was carried out by May and Baker Technology. It relates to the manufacture of a wide range of intermediate and finished pharmaceutical and chemical products. The study established that the choice of process was sensitive to the ultimate operating scale envisaged. It concluded the following: the existing process was profligate in the use of materials and energy and the energy bill could be reduced by nearly Pound 100,000/year by installing a heat pump and heat recovery exchangers, and improving the control over process conditions; the output of the existing plant could be increased by around 25% by installing a low pressure steam stripping system to recover the product; this would be worth approximately Pound 1 million/year for a capital expenditure of Pound 392,000; a new plant, based on the same technology, could be installed to meet a more substantial increase in product demand. The study has highlighted the value of process integration in the context of process evaluation and new process development. (author).

12994 (GB–335) **Cost reductions on a bulk chemicals plant: Identified by a process integration study at Coalite Fuels and Chemicals Ltd. [Chesterfield].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office; UKAEA Harwell Lab. (UK). Engineering Science Div. Apr 1988 45p. (EEO-RD–34/37). Order Number DE91752818. Source: OSTI; NTIS (US Sales Only).

Coalite's plant at Bolsover in Derbyshire refines and processes coal tar products. It is one of Europe's main producers of chlorinated phenols: used in the manufacture of agricultural and industrial chemicals. The plant also makes a wide range of synthetic and other tar based chemicals. The process integration study was carried out by Coalite in collaboration with the Energy and Process Integration (EPI) Service of Harwell Laboratory. The cost of the study was Pound 50,000, including time contributed by Coalite and EPI staff. Work was completed in ten months. The study established that the three plants studied could be modified to reduce the site fuel bill by more than Pound 700,000/year. (author).

12995 (GB–337) **Roof mounted oxy-fuel burners on an electric arc furnace: A demonstration at British Steel Tubes Division Clydesdale Works [Bellshill].** Department of Energy,

London (UK). Energy Efficiency Office; British Steel Corp., Rotherham (UK). Swinden Labs. Aug 1989 47p. (EEO-ED–263/287). Order Number DE91752801. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

A tangentially fired, roof mounted, oxy-gas burner system has been installed on No. 1 Furnace at Clydesdale Works. With estimated cost savings of Pound 570,000/year the payback period on the original investment cost of Pound 277,000 is six months. This project qualified for assistance under the energy Efficiency Demonstration Scheme because of the reduction in the primary energy requirement, and the potential for energy cost savings. The three burner system, which was installed in January 1987 has proved reliable, has had no adverse effects on the furnace structure or on steelmaking consumables and has been readily accepted by the operatives. There has been no noticeable increase in fume or noise emission. Evaluation of long term data indicates savings in specific electrical energy consumption for the whole furnace cycle of 60 kWh/t liquid and net time savings during melting of eleven minutes. It is estimated that 52 kWh/t liquid and a nine minute saving to melt can be attributed to operation with the burners and these values have been used in the economic analysis. These results imply that the overall efficiency of electrical energy replacement is 58% and that the primary energy savings are approximately 28,000 GJ/year. (author).

12996 (GB–339) **Automatic control system for rotary dryers: A demonstration at Laporte Earths [Redhill].** Department of Energy, London (UK). Energy Efficiency Office; Electrowatt Engineering Services Ltd., Horsham (UK). Nov 1989 46p. (EEO-ED–266/306). Order Number DE91752795. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Laporte Earths operate three rotary louvre dryers with a common feed system. This demonstration project involves the installation of a low cost control system on all three dryers. The system automatically controls the feed rate to achieve the outlet set point temperatures on each dryer. In addition, by modelling the performance of the dryer the system can predict the product moisture. This is compared to an existing infra red moisture meter reading and if the two agree the outlet temperature set points are altered to achieve the desired product moisture. Monitoring of the energy use before and after installation has shown that direct energy savings of 140,000 therms/year have been achieved, or 6% of dryer use. At Laporte this is worth Pound 28,000/year and gives a simple payback period of 14 months. In addition, with the control system ensuring a more uniform product moisture content, Laporte have the option of increasing the average product moisture whilst being confident of remaining within specification. The benefit of this would be an additional energy saving of 151,200 therms/year, worth Pound 30,200/year. This would reduce the payback period to 6 months. (author).

12997 (GB–340) **High temperature pre-heated combustion air system in a pottery tunnel kiln: A demonstration project at English Ironstone Tableware Ltd., Stoke on Trent.** Department of Energy, London (UK). Energy Efficiency Office; British Ceramic Research Ltd., Stoke-on-Trent (UK). Sep 1989 24p. (EEO-ED–232/261). Order Number DE91752792. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

A high-temperature pre-heated combustion air system has been installed in the initial cooling zone of a car tunnel kiln used for biscuit firing of earthenware flatware. Using the existing burner system the combustion air temperature was raised to 444°C and energy savings of 15.8% were achieved. This compares favourably with the predicted energy savings of 19%. Energy cost savings of Pound 12,800/year were realised giving a payback of 1.9 years on an investment of Pound 24,000. Further savings, estimated at Pound 25,000 were achieved through a reduction in dunting losses obtained through faster safe cooling to 600°C and slower cooling through the critical 600°C to 500°C range. Taking this saving into account the payback is reduced to 8 months. With a new burner system capable of handling combustion air at a temperature of 600°C the predicted energy savings are 28%. The improved performance of the kiln with the existing burner system suggests that, with new burners, energy savings of approximately 25% should be attained. With this new burner system, energy savings of 25% would be equivalent to Pound 20,200/year which would give a payback period of 2.1 years on a total investment of Pound 42,500. (author).

12998 (GB–341) **Cost reductions on a chemical works: Identified by a process integration study at Staveley Chemicals Ltd. [Chesterfield].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Oct 1987 40p. (EEO-RD–30/31). Order Number DE91752809. Source: OSTI; NTIS (US Sales Only).

A report given of a process integration study to determine the minimum practical amount of energy required to operate on chemical plant manufacturing a wide range of basic and intermediate organic chemicals. This project was part of the UK Energy Efficiency R and D programme. The design indicated three practical energy saving schemes with the potential to reduce the energy bill by up to 40% with a payback period of less than one year. (UK).

12999 (GB–342) **Cost reductions at an oil refinery: Identified by a process integration study at Shell UK Ltd. [Ellesmere Port].** Clayton, R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. May 1987 35p. (EEO-RD–19/26). Order Number DE91752810. Source: OSTI; NTIS (US Sales Only).

In 1984 Shell UK Ltd operated two oil refineries in the UK. Pinch Technology was applied to the No 4 crude oil distillation unit at Stanlow. This unit had an annual energy bill in the range Pound 12-13 million in 1984. The unit is required to operate satisfactorily with different crude oil feeds, producing a variety of product ranges at different throughputs. The cost of this study was Pound 65,000 and the duration of the work was six months. The objective was to identify the most appropriate investment strategy which would minimise energy costs and achieve a payback period of two years or less without affecting operating flexibility in any way. The main study identified an investment opportunity which fully meets the Shell criteria. When implemented, the energy cost savings will amount to Pound 1.6 million/year; a 12-15% reduction. The capital cost is estimated to be Pound 2.5 million, yielding a payback period of about 19 months. Implementation is planned for July 1987. Notable features of the study are the beneficial application of pinch technology to a large, complex oil refining process plant which includes an extensive heat recovery system; and the consideration of 12 different modes of operation including two types of crude feedstock and summer/winter temperature variations. (author).

13000 (GB–343) **Cost reductions on a grain whisky distillery: Identified by a process integration study at Long John International Ltd. [Glasgow].** Clayton. R.W. (UKAEA Harwell Lab. (UK). Energy Technology Div.). Department of Energy, London (UK). Energy Efficiency Office. Jul 1988 37p. (EEO-RD–4/9). Order Number DE91752811. Source: OSTI; NTIS (US Sales Only).

Long John International Ltd are part of the Whitbread Group and are whisky distillers and blenders. Process integration was applied to the company's grain whisky distillery in Glasgow. The total energy bill of this modern distillers can amount to Pound 1.5 million/year depending on production levels. The production of grain whisky involves both continuous and batch process. It includes the cooking of grain to yield soluble sugars, the fermentation of the sugars to alcohol, the recovery and purification of alcohol using a multi stage distillation process and the processing of waste materials for sale as animal feed. The cost of this Process Integration study was Pound 35,000. The work lasted five months. The study established that the practical minimum level of energy needed to run the site was 26% less than the current level of energy consumption. A strategy involving four discrete investment projects was developed. When implemented, the site energy consumption will be reduced by over Pound 200,000/year with a payback of 18-20 months. Notable features of the study are the beneficial application of process integration to sequential batch cooking operations and relatively small-scale distillation plant operated in a continuous mode. (author).

13001 (GB–344) **The use of direct stock temperature measurement as a means of control in a continuous slab reheating furnace: A demonstration at Brinsworth Strip Mill, Rotherham.** Department of Energy, London (UK). Energy Efficiency Office; British Steel Corp., Rotherham (UK). Swinden Labs. Mar 1990 64p. (EEO-ED–282/271). Order Number DE91752800. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

A report is presented on an Energy Efficiency Demonstration Project to improve the efficiency of fuel utilization in a reheating furnace in a strip mill. Radiation pyrometers have been installed in the roof of the slab reheating furnace to measure and control the temperature of the stock directly. The energy saving payback period obtained was less than a year and the new system has performed satisfactorily. The detailed monitored results of the performance and energy saving of the new system are presented and estimates made for the national energy savings arising from replication of the system in the UK. (UK).

13002 (Juel–2372) **Fixation of residues from special hazardous waste incinerators for shallow land disposal.** Assmann, D. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Chemische Technologie. Jul 1990. 56p. (In German). Order Number DE91756439. Source: OSTI; NTIS (US Sales Only).

The residues from special hazardous waste incinerators, the filter dust and the reaction products from off-gas purification - the salts, must be stored underground at special dumps. The volume of these special dumps is very limited. The fixation of the residues with water glass and $AlPO_4$-hardener reduces the leachability of heavy metals in such a good way, that these fixed residues can be dumped upon earth. (orig.).

13003 (NEI-DK–480) **Humleby: Pilot project on district heating supply.** Hoejlund Rasmussen (B.) Raadgivende Ingenioerer A/S, Copenhagen (Denmark). Nov 1990 119p. (In Danish). Contract EOeE-0034 (51121-0034). Order Number DE91752939. Source: OSTI; NTIS (US Sales Only).

Prepared for Husejerforeningen v. Vesterfaelledvej.

The aim was to investigate the possibilities and costs for utilizing the waste heat from The Carlsberg brewery near "Humleby" a group of building society houses in Copenhagen, Denmark. 4 methods of supply were investigated. 1A. A traditional supply of district heating from the Gas and Electricity services of Copenhagen. 1B. Humleby establishes its own energy supply company using the waste heat from the brewery or from the Gas and Electricity Services. 2. Humleby establishes its own energy supply company, which buys the waste heat form the brewery and the surplus or deficit heat is mutually exchanged with the Gas and Electriticity Services. 3. Humleby establishes its own energy company, which is a reserve central and buys as much waste heat as possible from the brewery. (CLS).

13004 (STU–89-1266) **Comversion study, oil-natural gas in a pusher furnace at Fundia Bygg in Halmstad.** Molin, A. (Sydkraft AB, Malmoe (SE)); Leden, B.; Dos Santos, A.M. Swedish National Board for Technical Development, Stockholm (Sweden). 24 Jul 1990. 92p. (In Swedish, English). Order Number DE91753040. Source: OSTI; NTIS (US Sales Only).

During 1989 a steel-reheating pusher furnace was converted from oil to natural gas firing. Within the context of the large-scale introduction of natural gas in Sweden, this was seen as a good opportunity to document changes in performance of the furnace. This knowledge can hopefully be an indicator to other energy using plants on the expected changes in performance due to the use of natural gas. Transition to the new fuel was without major incidents and performance increased for natural gas. Production was up by close to 5% and excess air down to less than 1%. Simultaneously NOX remained constant. Considering the fuel costs, this resulted in a net saving for the owner and offers good prospects for the increased number of plants which can benefit from conversion to natural gas.

3206 Municipalities and Community Systems

Refer also to citation(s) 12415, 12584, 12732, 12949, 13493, 13495, 13496, 13497

13005 (BFR-R–71-90) **Application of the GRUDIS-technique: A competition study.** Persson, Soeren (Studsvik Energy, Nykoeping (Sweden)); Nilsson, Jarl. Swedish Council for Building Research, Stockholm (Sweden). 1990. 60p. (In Swedish). Project BFR-890537-9. Order Number DE91753071. Source: OSTI; NTIS (US Sales Only).

A competition study have been made where the GRUDIS-system have been compared to conventional culvert technique with regard to culvert costs and total investment cost. The study shows that flexible plastic pipe culverts are competitive with copper pipe culverts in the entire dimension registers. For steel pipes the braking point for new areas lies at pipe dimension 75 mm diameter, and for existing areas at 90 mm diameter. The technique give lower investment costs for detached and row of houses but for apartment house areas the competition is more tense. (U.W.).

13006 (BSE-PROC–30, pp. 97-103) **Should locally pretreated industrial wastes be discharged to the municipal sewage system or to the stormwater system.** Rennerfelt, J. (KTH and K-Konsult, Stockholm (SE). Department of Biotechnology). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas*. 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Stormwater, cooling waters and well pretreated industrial wastes without biodegradable organic substances should be discharged to the stormwater system. Industrial wastes containing biodegradable organic substances should be discharged to the sewage system and treated together with the municipal sewage.

13007 (BSE-PROC–30, pp. 75-78) **Slide rule methods for estimation off pollution load due to stormwater.** Falk, J. (National Environmental Protection Board (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas. Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas*. 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Published in summary form only. URBAN AREAS/water pollution control; SEWAGE; WASTE PROCESSING PLANTS; CALCULATION METHODS; WASTE WATER; WATER POLLUTION; RAIN; RUNOFF; WASHOUT; PIPELINES

13008 (BSE-PROC–30, pp. 46-64) **Quality aspects on and methods for reduction of combined sewer overflow discharge.** Hogland, W. (Lund Institute of Technology/University of Lund (Sweden). Department of Water Resources Engineering); Berndtsson, R.; Larson, M. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas*. 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Combined sewer overflow discharge is a pollution problem which has been largely neglected in most of the world. However, during the last five years extensive studies have been carried out in the Nordic countries in order to clarify CSO-problems. A Nordic cooperation project on the importance of sediment wash-out for the combined sewer overflow quality is currently under way. After a short summing up of combined sewer overflow pollution problems and a survey of the research in this field this paper presents some methods of pollutant reduction and discusses their effects.

13009 (DOE/CE/27504–1) **Energy Task Force of the Urban Consortium for Technology Initiatives: Applied research units and projects year 11 (1989-90) program: Summary and abstracts.** Public Technology, Inc., Washington, DC (USA). Sep 1989. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-90CE27504. Order Number DE91008035. Source: OSTI; NTIS; GPO Dep.

The Urban Consortium for Technology Initiatives is an organized coalition that brings together 46 of America's largest cities and urban counties to focus on how applied research, advanced management systems and technology can improve urban services. The Urban Consortium Energy Task Force (UCETF) has a special focus on the improvement of urban energy management and technology. Defined to meet both the needs of cities and counties as well as national priorities as recommended from USDOE's Energy Security analyses, major topics within the program are: (1) Electricity (load and conservation) management; (2) Waste management; (3) Energy, economic development and environment and (4) Alternative vehicular fuels and technologies. The UCETF has well established partnerships with USDOE and among its city and county members. Major efforts have been placed on the expansion of these partnerships with private industry, state governments and academia. Effective partnerships with energy utilities and other organizations began for 1988–89 projects for alternative vehicle fuels, electricity management and sustainable communities. The UCETF is a mature organization with a ten year history and a solid record of accomplishments. To better transfer these accomplishments to benefit other cities and counties, the UCETF program places a major focus on technology transfer through specifically designed projects, print and electronic media, and a series of workshops and conferences. The summary contains short descriptions of the projects and participarts in the eleventh year (1989–90) program of the UCETF.

13010 (ETDE-mf–1759403) **Heat treatment of flue and filter dusts of waste incineration plants by plasma furnace technology. Final report.** Klein, H. Krupp MaK Maschinenbau GmbH, Kiel (Germany, F.R.). Fachgebiet Umwelt-, Verfahrens- und Energietechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jan 1989 39p. (In German). Contract BMFT 1440551. Order Number DE91759403. Source: OSTI; NTIS (US Sales Only).

The removal of the toxic filter dusts resulting from waste incineration plants becomes progressively more problematically. For the time being there does not exist a fully developed technology for the treatment and salvage of these residual substances. Within the scope of a pilot project the heat-treatment of filter dusts was tested by means of threephase plasma technique. Harmful organic substances are decomposed completely in the plasma reactor, slightly volatile metallic salts and heavy metals are separated from the dross remaining in the reactor and concentrated in a rearpositioned condensating plant. The resulting products as dross, salt and heavy-metal concentrate can be put on the market and will serve for a better total economy. There will be no residues in the final stage of this procedure, so that deposits are not required. (orig.) With 4 tabs., 11 figs.

13011 (ETDE-mf–1759511) **Further development of language-orientated data structures in the guidance and simulation of electric power supply systems.** Post, U. Duisburg Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 9 - Elektrotechnik. 13 Nov 1989 166p. (In German). Order Number DE91759511. Source: OSTI; NTIS (US Sales Only).

The work is based on the mains plans of 'Kraftwerke Laufenburg' public utility and on the rest of the mains control system installed there by the Siemens firm. Both the high voltage mains and (in extension of previous cases of application) the mean voltage mains were described in mains data language. In this sense, the following techniques were designed in the present dissertation and were implemented as a prototype: A universal query and instruction language for interaction with the data base. Automatic generation of a function keyboard including definition of the key function, calculating the layout, plotting and startup. This function keyboard can be used for the user-friendly formulation of the query and instruction language. The switch sequence is generated directly from interpretation of the mains topology. (orig./GL).

13012 (PNL–7590-Vol.1) **Characterizing residential thermal performance from high resolution end-use data: Volume 1, Methodology.** Miller, N.E.; Pearson, E.W.; Stokes, G.M.; Pratt, R.G.; Williamson, M.A. Pacific Northwest Lab., Richland, WA (USA). Jan 1991. 36p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008602. Source: OSTI; NTIS; GPO Dep.

The Bonneville Power Administration (Bonneville) began the End-Use Load and Consumer Assessment Program (ELCAP) in 1983. Prior to beginning the ELCAP, there was an abundance of information regarding total power consumption for residential structures in the Pacific Northwest and limited information regarding power consumption by various end uses. The purpose of ELCAP is to collect actual end-use load data from both residential and commercial buildings in the region. This report presents the methodology used in several statistical modeling studies carried out on the ELCAP data between 1986 and 1989. These studies involve the thermal characterization of homes and comparisons of building techniques and conservation measures by residential and commercial consumers within the Bonneville service area of the Pacific Northwest. Each data gathering technique was successful in extracting a specific set of consumer-related energy use information. The analytical techniques used in these studies are compiled in this methodology report and are to be used in conjunction with Volume 2 – Analysis. This should facilitate ease of reference use during future analyses. It is anticipated that the data gathered on participating consumers could potentially be used to aid in decisions regarding the management of the Northwest's electrical energy resources. 7 refs., 6 figs., 2 tabs.

13013 (SB-US–90-41) **Fuel-driven heat pumps.** Tvaerne, A. Statens Vattenfallsverk, Vaellingby (Sweden). 1990. 73p. (In Swedish). Order Number DE91753037. Source: OSTI; NTIS (US Sales Only).

The purpose of this study has been to analyse the economic conditions for and the competitiveness of fuel-driven heat pumps. This has been done through a technical description of all components and subsystems that make up a fuel-driven heat pump unit, as well as through an economic analysis with calculations for three installations where Vattenfall is responsible for operation and maintenance of heat pumps that could be converted into fuel-driven units. A fuel-driven heat pump is, at least in this study, defined as an electricity and heat generating combination of an IC engine, a generator and a heat pump. The electricity produced by the engine/generator is primarily used to drive the heat pump, but can also be fed into the grid. The heat pump can, if so is desired, be fed from the grid instead of from the engine generator. A common design consists of direct heat recovery from exhaust gases and engine cooling system, the high-temperature sources, while the heat pump primarily uses some external heat source such as cleaned sewage water. Some of the engine's low-temperature sources, such as space and generator heat, air cooler and a possible exhaust gas cooler, can also be used by the heat pump to improve the COP. The calculations show that fuel-driven heat pumps, with the engine size adapted to the power need of the heat pump, are less economical than the existing alternatives. What should be chosen instead, is either a straight cogeneration solution, with the engine sized after the needs of the full heat load, or to keep existing systems with electricity-driven heat pumps and hot water boilers.

13014 (SVF–364) **Strategy for maintenance of distribution networks: Preliminary study.** Stroemwall, L. (Malmoe Energi (SE)); Lemmeke, L. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Jan 1990. 133p. (In Swedish). Order Number DE91753051. Source: OSTI; NTIS (US Sales Only).

The purpose of this study has been to produce a basis for development of a computerized planning system for maintenance of distribution networks for energy. The planning system should make it possible to assess both maintenance costs and service level. The main objects of the study have been: to state simple principles in order to determine a standard for the service level; for a chosen level of service to establish an optimum balance between preventive and repair maintenance; to state an optimum level of service; and to set the principles for a maintenance system with respect to both costs and service level. The study has been directed to application to networks for district heating primarily and secondarily for distribution of natural gas (thus omitting electrical networks). A review of common networks for district heating and distribution of natural gas has been made. Based on this review a model for calculation of the service level of a distribution network is presented. The model produces a dimensionless parameter, which expresses the supply safety for the network and makes it possible to compare

different networks or different designs of network. An outline of a planning system for maintence and renewal is presented. The system comprises an operational plan based on the actual conditions and a long term plan of future conditions based on statistical data. The long term plan makes it possible to assess all activities and consequences including both costs and service level. It can therefore be used to compare different development trends and action programs.

13015 (SVF–365) **Results from dynamic tests of heat exchangers using process identification.** Walletun, H. (Studsvik Energy, Nykoeping (Sweden)); Oddving, B.; Bergdahl, B.G. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Jan 1990. 33p. (In Swedish). (STUDSVIK-ED–89-15). Order Number DE91753052. Source: OSTI; NTIS (US Sales Only).

Studsvik AB has built a test circuit for functional testing of heat exchangers used in district heating. The test program has been in operation since 1986 and about 60 different heat exchangers have been evaluated. The purpose of this project is primarily to find conditions to complement the present test program with a dynamic one for practical use at tap water heat exchanger tests. Another purpose has been to find measurable variables, i.e. time constants, to be able to describe the dynamic performance of a heat exchanger. The measurement principle during the investigations has been process identification based on noise analysis. The principle has proved itself successful and gives accurate and reproducible results. It seems that the measurement principle is also well suited to be used with more general dynamic studies. The report presents the dynamic test results and includes a modified program for functional testing of tap water heat exchangers. (authors).

3209 Education and Public Relations

Refer also to citation(s) 12614

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 12318, 12417, 12922, 12950, 13198

13016 (CONF-9006105–14) **MHD channel gas-side element erosion-corrosion studies.** Pollina, R.J. (Avco-Everett Research Lab., Inc., Everett, MA (USA)); Simpsom, W.; Farrar, L.C. Avco-Everett Research Lab., Inc., Everett, MA (USA); Montec Associates, Inc., Butte, MT (USA). [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88928 ;AC22-87PC90274. (CONF-900749–1: 28. symposium on engineering aspects of magnetohydrodynamics; University coal research and historically black colleges and universities contractors review, Chicago, IL (USA); Pittsburgh, PA (USA), 26-28 Jun 1990; 16-19 jul 1990). Order Number DE91008561. Source: OSTI; NTIS; GPO Dep.

The problems connected with gas side corrosion for the design of the 1A4 channel hardware are explored and the authors present the results to date of gas side wear rate tests in the Mark 7 facility. They show that the proposed designs meet a 2000 hour lifetime criterion based upon materials test results. They also show the improvement in cathode lifetime obtained with lower voltage intercathode gaps. Finally the authors discuss the corrosion of these materials and show how lifetimes are dependent upon gap voltage and average metal temperature. The final choice of materials is determined primarily by the outcome of these tests and also by the question of the manufacturability of the prospective designs. 6 figs., 6 tabs.

13017 (DOE/NASA–0336-2) **Advanced Turbine Technology (ATTAP) Applications Project: 1989 Annual report, final.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div. 2 Jul 1990. 137p. Sponsored by USDOE, Wash. DOE Contract AI01-85CE50111. (NASA-CR–187039;EDR–14585). Order Number DE91008223. Source: OSTI; NTIS; GPO Dep.

The overall intent of this project is to bring the automotive gas turbine engine to a technology state at which industry can make commercialization decisions. Key to this goal is the development and demonstration of structural ceramic component technology as the critical high risk/high payoff element in this type of engine. Such ceramic technology is the prime focus. Engine/powertrain design and development, analysis, and materials assessment; ceramic component design; materials characterization and ceramic component fabrication; component rig development and test; and performance and durability testing–test-bed engines. 139 figs., 31 tabs.

13018 (ETDE-mf–1756887) **Reducing the emission of raw hydrocarbons of an Otto-engine during cold start and during instationary cold run.** Schmidt, H. Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik. 17 Nov 1989 177p. (In German). Order Number DE91756887. Source: OSTI; NTIS (US Sales Only).

The thesis studies possibilities of reducing the emission of unburnt hydrocarbons from Otto-engines during cold start and the initial running phase while the engine is still cold. CH-emissions were reduced by experimental optimation of the fuel-air ratio and energy conversion system. The reasons for CH-emission of four-stroke Otto engines and the exhaust gas emissions are described. The structure of the test is explained (mixture formation, ignition, test engine, drive, exhaust gas flow, recording of measured values) as well as the preliminary studies which refer to the criteria for the assessment of energy conversion, determination of stationary minimum values of CH in dependence of the operating point and the suitability of the measuring instruments for dynamic operation. The studies of instationary cold run comprised the determination of set values, measurements for the realisation of reproducability and the optimation of the fuel-air ratio. (HWJ).

13019 (IFP–38124) **Contribution to the numerical simulation of a two stroke engine.** Habchi, C. Paris-6 Univ., 75 (France); Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France). May 1990. 194p. (In French). Order Number DE91753119. Source: OSTI; NTIS (US Sales Only).

Simulation of aerodynamical flow inside the combustion chamber of a two stroke engine is the aim of this thesis. Based on the KIVA code, this work examines especially the modelling of admission and exhaust for combustion control and optimization of fuel consumption. Mesh generation and automatic adaptation to real 3D-geometry of combustion chamber and boundary conditions for numerical simulation of turbulent flow are studied.

3303 Electric-Powered Systems

Refer also to citation(s) 12875

13020 (JPL-D–7824) **Viability study of photo-voltaic systems added to terrestrial electric vehicles.** Rippel, W.E. Jet Propulsion Lab., Pasadena, CA (USA). Sep 1990. 182p. Sponsored by USDOE,. DOE Contract AI01-85CE89008. Order Number DE91007689. Source: OSTI; NTIS; GPO Dep.

The purpose of the following computer study is to determine the set of necessary conditions under which the addition of photovoltaic (PV) cells to electric vehicles provides a net utility or economic benefit. Economic benefits are given the primary focus and are evaluated in terms of a payback period.

3306 Vehicle Design Factors

Refer also to citation(s) 13045, 13208

13021 (GB–322) **Fuel savings in trucks through aerodynamic styling: A demonstration at Exel Logistics [Bedford].** Department of Energy, London (UK). Energy Efficiency Office. Jun 1990 25p. (EEO-ED–286/335). Order Number DE91752802. Source: OSTI; NTIS (US Sales Only).

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

An integrated approach has been applied to the aerodynamic styling of 17 tonne gross vehicle weight (GVW) rigid box bodied vehicles. Two prototype vehicles have been built and compared with two matched vehicles having no aerodynamic aids. Each of the two aerodynamically styled vehicles have been built and compared with two matched vehicles having no aerodynamic aids. Each of the two aerodynamically styled vehicles was monitored alongside a standard vehicle over a ten month period on a normal distribution service operated by Exel Logistics at two Argos depots. The aerodynamically styled vehicles did 23% more miles to the gallon than the standard trucks. For an annual mileage of 50,000 the fuel saving is 866 gallons of DERV/year per vehicle, worth Pound 1180 at 1990 prices. Based on this saving the simple payback period is 1.6 years. (author).

3307 Emission Control

Refer also to citation(s) 13018

13022 (VW-FMT–8903-V/5) **A fast method for detecting selected PAH and 1-nitropyrene in car exhaust.** Volkswagenwerk AG, Wolfsburg (Germany, F.R.). Abt. Forschung und Entwicklung. 24 Apr 1989. 25p. (In German). Order Number DE91754897. Source: OSTI; NTIS (US Sales Only).

As a result of incomplete combustion in car engines, car exhaust contains PAH and PAH-derivatives. Sensitive methods are required for a complete analysis of these compounds, but a fast survey is possible on the basis of a few selected compounds. A fast method is described which combines high-pressure liquid chromatography (HPLC), UV/VIS diode array (DAD) and fluorescence detection. DAD permits on-line recording of single component spectra for a comparison with reference spectra. The detection limit of the DAD is in the lower nanogram range. For maximum sensitivity in the lower picogram range, a fluorescence detector is used. The analytical results are well compatible with the results of gas chromatography for the different vehicle types (passenger cars with diesel engines and spark ignition engines, with or without catalysts). The gas chromatography technique, however, requires much more careful processing of the samples. (orig.).

3308 Alternative Fuels

Refer also to citation(s) 12577

13023 (VTT-TIED–1187) **Use of natural gas and liquefied petroleum gas in heavy-duty engines: Literature review.** Nylund, N.O. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Polttoainetekniikan laboratorio): Kytoe, M.; Eklund, T. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1990. 76p. (In Finnish). Order Number DE91752990. Source: OSTI; NTIS (US Sales Only).

Exhaust gas emissions from heavy-duty vehicles will be reduced in the 1990s to the level hardly achievable with conventional diesel technique. Alternative uses of natural gas and liquefied petroleum gas (LPG) and experiences from their use as the fuel of heavy-duty vehicles are reviewed in this note mainly with reference to literature and, to a minor extent, to own experiments. Natural gas and LPG are good engine fuels. As regards LPG, only propane can be used in Finland's climate. These gases are used nearly exclusively in spark-ignition engines, but can also be used stationary engines as the main fuel of the diesel engine. The greatest problems relate to their rather low energy density and high storage pressure. The fuel tanks are pressure vessels and require a lot of space. The output of uncharged gas engines is higher than that of corresponding diesels, but lower than of charged diesels. The spark-ignition engines of heavy vehicles are nearly without exception based on diesel engines. The simplest modification requires reduction in compression ratio and construction of an ignition system and gas feed. It is easy to change an otto engine modified from a diesel in a vehicle, as changes are required only in the motor. The cleanest exhaust gases are obtained from a gas engine equipped with a threeway catalyst. Very clean exhaust gases are also achieved with leanblend engines compared to those of a diesel. The exhaust gasees of the gas engines contain a very low amount of particles, while, for example, an engine operating on a stoichiometric blend ratio produces an abundance of gaseous emission components, if the exhaust gases are not cleaned up catalytically. In an engine equipped with a threeway catalyst, natural gas and LPG are equal fuels with regard to the purity of exhaust gases.

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

13024 (PNL-SA–18728) **Options and regulatory issues related to disposition of fissile materials from arms reduction.** Bloomster, C.H.; Hendrickson, P.L.; Killinger, M.H.; Jonas, B.J. Pacific Northwest Lab., Richland, WA (USA). Dec 1990. 77p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910208–1: Annual meeting of the American Association for the Advancement of Science: earth science, Washington, DC (USA), 15-19 Feb 1991). Order Number DE91008750. Source: OSTI; NTIS; GPO Dep.

This study evaluates potential options for retiring large quantities of plutonium and highly enriched uranium from strategic stockpiles in response to a nuclear arms reduction agreement. Four broad categories of options for disposing of the fissile material are evaluated: Monitored and Secured Storage, Use as Nuclear Fuel, Detonation, and Disposal. Each category contains a number of technically feasible alternatives. The retirement options of evaluated according to seven criteria that are considered important to implementing an arms reduction agreement: (1) Verifiability, (2) Proliferation Resistance, (3) Cost, (4) Irreversibility, (5) Technical Availability, (6) Safety and Environmental Risk, and (7) Political and Public Acceptance. This paper also covers in a preliminary fashion various regulatory issues that may effect the disposition of fissile materials from retired weapons. The emphasis is on federal requirements, although some discussion of state and local transportation requirements is included. The National Environmental Policy Act will impact any of the disposition options. It is likely that either an environmental assessment or an environmental impact statement covering the options will need to prepared. Requirements of the US Department of Transportation and state and local governments relating to the transportation of radioactive materials are also likely to be applicable. 24 refs., 2 figs., 4 tabs.

3502 Proliferation

Refer also to citation(s) 13024

3503 Verification

13025 (CONF-9009295–2) **Bar codes and intrinsic-surface-roughness tag: Accurate and low-cost accountability for CFE.** DeVolpi, A.; Palm, R. Argonne National Lab., IL (USA). [1990]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 2. workshop on verification of arms reduction: Vienna (Austria): 3-5 Sep 1990. Order Number DE91007752. Source: OSTI; NTIS; GPO Dep.

CFE poses a number of verification challenges that could be met in part by an accurate and low-cost means of aiding in accountability of treaty-limited equipment. Although the treaty as signed does not explicitly call for the use of tags, there is a provision for recording "serial numbers" and placing "special marks" on equipment subject to reduction. There are approximately 150,000 residual items to be tracked for CFE-I, about half for each alliance of state parties. These highly mobile items are subject to complex treaty limitations: deployment limits and zones, ceilings subceilings, holdings and allowances. There are controls and requirements for storage, conversion, and reduction. In addition, there are national security concerns regarding modernization and mobilization capability. As written into the treaty, a heavy reliance has been placed on human inspectors for CFE verification. Inspectors will mostly make visual observations and photographs as the means of monitoring compliance: these observations can be recorded by handwriting or keyed into a laptop computer. CFE is now less a treaty between two alliances than a treaty among 22 state parties, with inspection data an reports to be shared with each party in the

official languages designated by CSCE. One of the potential roles for bar-coded tags would be to provide a universal, exchangable, computer-compatible language for tracking TLE. 10 figs.

36 MATERIALS

Refer also to citation(s) 13760

13026 (DOE/ER/45379–2) **Synchrotron studies of x-ray reflectivity from surfaces: Progress report.** Pershan, P.S. Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences. 2 Nov 1990. 2p. Sponsored by USDOE,. DOE Contract FG02-88ER45379. Order Number DE91007883. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. X RADIATION/reflection; SURFACES/optical properties; REFLECTION; SURFACES; MERCURY; WETTABILITY; METALS; GALLIUM; SYNCHROTRON RADIATION; PROGRESS REPORT

13027 (UCID–21798) **INGRID: Entering material specifications.** Wayne, B.M. Lawrence Livermore National Lab., CA (USA). Jul 1989. 87p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91008424. Source: OSTI; NTIS; GPO Dep.

This document discusses material specifications entering into INGRID. INGRID is a three-dimensional mesh generator for modeling nonlinear systems. (JL)

13028 (UCID–21868) **PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions.** Engelmann, B.E.; Whirley, R.G.; Shapiro, A.B. Lawrence Livermore National Lab., CA (USA). 26 Mar 1990. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91008423. Source: OSTI; NTIS; GPO Dep.

This manual describes the PALM2D analysis code. PALM2D solves for the coupled thermomechanical response of axisymmetric or plane strain solids, including nonlinear effects. This initial version of PALM2D borrows heavily from the LLNL codes TOPAZ2D for the solution of the thermal problem and NIKE2D for the solution of the mechanical problem. The thermal problem may include temperature dependent thermal conductivities and convection boundary conditions, and the mechanical problem may include large deformations and strains as well as material nonlinearities such as plasticity. Coupling is achieved through a staggered step formulation. Heat generation due to plastic work is included, and all heat transfer computations are done on the deformed geometry. PALM2D is a rapidly evolving code, and many enhancements are expected in the near future. 4 refs., 6 figs.

3601 Metals and Alloys

Refer also to citation(s) 12304, 12318, 12548, 12592, 12635, 12636, 12804, 12983, 12984, 13090, 13098, 13168, 13194, 13237, 13254, 13323, 13817, 13818

13029 (BNL–45484) **XANES [X-ray Absorption Near Edge Structure] investigation of cerium as an inhibitor for Al alloys.** Davenport, A.J. (Brookhaven National Lab., Upton, NY (USA)); Isaacs, H.S.: Kendig. M.W. Brookhaven National Lab., Upton, NY (USA). [1991]. 3p. Sponsored by USDOE. Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910552–2: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91005542. Source: OSTI; NTIS; GPO Dep.

Cerium ions are under investigation as possible replacements for toxic chromates. The use of cerium ions as corrosion inhibitors for aluminum alloys is investigated using XANES (x-ray absorption near edge structure). On immersion in a dilute solution of cerium ions, cerium is incorporated into the oxide films on aluminum alloys in either the 3- or 4-valent state depending upon the alloy and on the surface preparation. 7 refs., 2 figs.

13030 (BNL–45592) **The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion.** Lillard, R.S. (Johns Hopkins Univ., Baltimore, MD (USA)); Moran, P.J.; Isaacs, H.S. Brookhaven National Lab., Upton, NY (USA). [1991]. 2p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910552–3: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91006918. Source: OSTI; NTIS; GPO Dep.

Recently, the authors have proposed a method for generating local electrochemical impedance maps of electrodes. In this technique impedance maps, at each frequency of interest, are generated by measuring the ratio of ac solution current density, very near the electrode, to the applied potential is measured as a function of position. A review of this method, the results from two model systems, which demonstrate that this technique may be used to generate quantitative data, and its use to investigate aluminum alloys will be presented. 7 refs., 3 figs.

13031 (BNL–45593) **In-situ x-ray measurements of pit solutions during localized corrosion.** Cho, J.H.; Davenport, A.J.; Isaacs, H.S. Brookhaven National Lab., Upton, NY (USA). [1991]. 2p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910552–5: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91006916. Source: OSTI; NTIS; INIS; GPO Dep.

In this work, in-situ x-ray absorption spectroscopy (XAS) measurements of the ion concentrations within an artificial pit are presented to study the ionic species present and mass transport phenomena during localized corrosion taking place on metal surfaces. The x-ray absorption by an element in a sample is markedly greater at an energy just above than just below one of its absorption edges and the energy of this edge is characteristic of the absorbing element. A pair of measurement above and below the edge serves to determine both the presence and the amount of the element sought. 9 refs., 3 figs.

13032 (BNL–45594) **A study of the inhibition of pitting of aluminum by chromate.** Hawkins, J. (University of Manchester Inst. of Science and Technology (UK). Corrosion and Protection Centre); Thompson, G.E.; Wood, G.C.; Isaacs, H.S. Brookhaven National Lab., Upton, NY (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910552–4: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91006915. Source: OSTI; NTIS; GPO Dep.

The location of chromate activity during the pitting corrosion of aluminum has been studied. Scanning vibrating probe technique monitored the current densities above cathodic and anodic sites and SIMS was used to determine the location of chromium reduction products. Products deposited preferentially on cathodes but chromates dramatically inhibited the anodic pitting processes. 8 refs., 3 figs.

13033 (BNL–45651) **Spatial and temporal relationships between localized microbial metabolic activity and electrochemical activity of steel.** Franklin, M.J. (Tennessee Univ., Knoxville, TN (USA). Dept. of Microbiology); Guckert, J.B.; White, D.C. Brookhaven National Lab., Upton, NY (USA). [1991]. 14p. Sponsored by USDOE,. DOE Contract AC02-76CH00016 ;AC05-84OR21400. (CONF-910328–3: NACE corrosion '91 symposium, Cincinnati, OH (USA), 11-15 Mar 1991). Order Number DE91008102. Source: OSTI; NTIS; GPO Dep.

The relationship between the localized microbial activity and localized electrochemical on corroding steel surfaces was investigated. The scanning vibrating electrode technique provided a sensitive means for defining local anodic and cathodic currents associated with corrosion. Localized bacterial metabolic activity was determined using autoradiography of bacterial incorporated ^{14}C-acetate into insoluble cell material. Microautoradiography of individual bacteria, with the incorporated acetate, was used to determine percentages and morphological types of active bacteria. The results showed a correlation between the location of anodic activity of the steel and the location of incorporated label. Although the results do not necessarily indicate a role for bacterial activity in the initiation of pitting, the results suggest that the actively metabolizing bacteria may exacerbate the propagation of pits by colonizing active anodic sites. 18 refs., 4 figs., 1 tab.

13034 (CEA-INSTN-PAS–90-9-2) **Trapping of positron in gallium arsenide: evidencing of vacancies and of ions with a negative charge.** Pierre, F. Institut National des Sciences et Techniques Nucleaires (INSTN) - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-11 Univ., 91 - Orsay (France). Dec 1989. 146p. (In French). Order Number DE91752723. Source: OSTI; NTIS (US Sales Only).

Vacancy type defects in Ga As as grown and irradiated by electrons are characterized by lifetime of positrons. Positron lifetime increases from 230 ps to 258 and 295 ps in presence of native vacancies in n type Ga As. Configuration of native vacancies changes when Fermi level crosses energy levels localized in the forbidden zone at 0.035eV and at 0.10eV from the bottom of the conduction band. Native vacancies are identified to arsenic vacancies with or without other point defects. Positron lifetime increases from 230 to 260 ps in presence of vacancies produced by low temperature irradiation negative ions are also produced. In irradiated Ga As, these ions trap positrons in competition with vacancies produced by irradiation, showing they have a negative charge. Two annealing zones between 180-300K and 300-600K are presented by vacancies. Ions do not anneal below ambient temperature. Vacancies and negative ions are identified respectively to gallium vacancies and gallium antisite.

13035 (CNEA-D-DP-FQP–110) **Carbon steel protection in G.S. [Girdler sulphide] plants: Pt. 7: Environment exposure effects on iron sulphide scales and subsequent treatment in plant conditions.** Lires, Osvaldo; Delfino, Cristina; Rojo, Enrique. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Desarrollo de Procesos. 1989. 14p. (In Spanish). Order Number DE91623266. Source: OSTI; NTIS (US Sales Only); INIS.

In order to protect carbon steel towers and piping of a GS experimental heavy water plant against corrosion produced by the action of aqueous solutions of hydrogen sulphide, a method, elsewhere published, was developed. Carbon steel exposed to saturated aqueous solutions of hydrogen sulphide forms iron sulphide scales. In oxygen free solutions, evolution of corrosion follows the sequence mackinawite → cubic ferrous sulphide → troilite → pyrrotite → pyrite. Scales formed by pyrrotite and pyrite are the most protective layers (these are obtained at 130 deg C, 2 MPa for a period of 14 days). During a plant shutdown procedures, the carbon steel protected with those scales is exposed to water and highly humid air; under such conditions oxidation is unavoidable. Later, treatment in plant conditions does not regenerate scales because the composition of regenerated scales involves more soluble iron sulphides such as mackinawite and troilite. Therefore, it is not recommendable to expose the protective scales to atmospherical conditions. (Author).

13036 (CNEA-D-DP-FQP–111) **Fused salt electrolysis: Preparation of zirconium metal.** Ares, Osvaldo; Botbol, Jose. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Desarrollo de Procesos. 1989. 12p. (In Spanish). Order Number DE91623260. Source: OSTI; NTIS (US Sales Only); INIS.

Working conditions for zirconium preparation by fused salt electrolysis were studied. For such purpose, a cell was built for operation under argon atmosphere. A graphite crucible served as anode, with steel cathodes. Proper design allowed cathode rechange under the inert atmosphere. Cathodic deposits of zirconium powder occluded salts from the bath. After washing with both water and hydrochloric acid, the metallic powder was consolidated by fusion. Optimum operating conditions were found to arise from an electrolyte of 12% potassium hexafluorzirconate -88% sodium chloride, at 820 deg C and 5 A/cm^2 cathodic current density. Deposits contained 35% of metal and current efficiency reached 66%. The powder contained up to 600 ppm of chlorine and 1.700 ppm of fluorine; after fusion, those amounts decreased to 2 ppm and 3 ppm respectively, with low proportion of metallic impurities. Though oxygen proportion was 4.500 ppm, it should be lowered by improving working conditions, as well as working on an ampler scale. (Author).

13037 (CNEA-D-DP-FQP–113/301) **Carbon steel protection in G.S. [Girdler sulphide] plants: Pt. 8: Oxygen and sulphur aggregate's influence.** Lires, Osvaldo; Delfino, Cristina; Rojo, Enrique. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Desarrollo de Procesos. 1990. 29p. (In Spanish). Order Number DE91623267. Source: OSTI; NTIS (US Sales Only); INIS.

In order to protect carbon steel of towers and piping of a GS experimental heavy water plant against corrosion produced by the action of aqueous solutions of hydrogen sulphide, a method, elsewhere published, was developed. Carbon steel exposed to saturated aqueous solutions of hydrogen sulphide forms iron sulphide scales. In oxygen free solutions, evolution of corrosion follows the sequence mackinawate → cubic ferrous sulphide → troilite → pyrrotite → pyrite. Scales formed by pyrrotite and pyrite are the most protective layers (these are obtained at 130 deg C, 2 MPa for a period of 14 days). Pyrite formation is favoured by an oxidizing agent presence that allows the oxidation of sulphur ions to disulphur ions. Elemental sulphur or oxygen were used as oxidating agents. Variation and operational parameters such as concentration, temperature, pH, aggregate time, etc. were studied. Though little improvement on protective scales quality was observed, results do not justify operational troubles and the additional costs and effort involved. (Author).

13038 (CNEA-D-DP-FQP–114/302) **Titanium metal obtention by fused salts electrolysis.** Perillo, P.M.; Ares, Osvaldo; Botbol, Jose. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Desarrollo de Procesos. 1989. 13p. (In Spanish). Order Number DE91623261. Source: OSTI; NTIS (US Sales Only); INIS.

Potassium fluorotitanate dissolved in fused sodium chloride or potassium chloride may be electrolyzed under an inert gas atmosphere. Solid electrolysis products are formed on the cathode which contains titanium metal, sodium chloride, lower fluorotitanates and small quantities of alkali metal fluorotitanate. The extraction of titanium from the electrolysis products may be carried out by aqueous leaching (removal of chloride salts of alkali metals and a certain amount of fluorotitanates). Titanium metal obtained is relatively pure. (Author).

13039 (CONF-9007149–6) **Measurement of residual stresses by x-ray diffraction near simulated heat affected zones in austenitic stainless steels.** Iyer, V.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Dept. of Materials Engineering); Hendricks, R.W.; David, S.A. Oak Ridge National Lab., TN (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Dept. of Materials Engineering. [1990]. 9p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From 39. annual Denver x-ray conference; Steamboat Springs, CO (USA); 30 Jul - 3 aug 1990. Order Number DE91008874. Source: OSTI; NTIS; GPO Dep.

Simulated heat-affected zones (HAZs) were made in austenitic stainless steel specimens using a Gleeble. The samples were heated to temperatures as high as 1100°C by computer controlled resistance heating. By controlling the heating rate, maximum temperature, and cooling rate, a wide range of residual stresses were introduced in the specimens. Stress measurements were made using X-ray diffraction. It was found that significant stress gradients were produced in the simulated HAZs, and that all stresses were compressive in nature, both in the longitudinal and transverse directions. These results are not representative of the residual stresses determined in the HAZs of real welds, thus calling into question some aspects of the role of the Gleeble in such simulations. 9 refs., 8 figs.

13040 (DOE/ER/13759–4) **Modeling of dendritic solidification systems: Reassessment of the continuum momentum equation and application to solidification of a lead-tin alloy: Annual report.** Prescott, P.J.; Incropera, F.P. Purdue Univ., Lafayette, IN (USA). Heat Transfer Lab. Feb 1991. 70p. Sponsored by USDOE,. DOE Contract FG02-87ER13759. Order Number DE91008228. Source: OSTI; NTIS; GPO Dep.

In recent years there has been renewed interest in modeling transport phenomena associated with the dendritic solidification of binary mixtures. Solidification occurs in a two-phase (mushy) region characterized by complex, solid-liquid interfacial geometries, and development of a model which is amenable to solution dictates the use of continuum (mixture theory) assumption and/or volume-averaging procedures. A review of the recent literature would

suggest that solidification models developed from mixture theory assumptions are less valid and less general than similar models based on volume-averaging, particularly with regard to the respective momentum equations which describe interdendritic fluid flow. In this report, these different approaches are shown to yield identical macroscopic conservation equations, and the continuum momentum equation is reconsidered in an effort to reconcile matters which have lead to confusion about the validity of the continuum model. Consistency between recently presented momentum equations is demonstrated. Using a continuum model for conservation of total mass, momentum, energy and species, numerical simulations of a binary metal alloy (Pb-Sn) undergoing solidification phase-change are performed. The system is contained in an axisymmetric, annular mold, which is cooled along its outer vertical wall. Results show that thermosolutal convection in the melt and mush zones is strongly coupled land that macrosegregation is reduced with increased cooling rate. For low cooling rates, solutally induced convection in the mushy zone favors the development of channels, which subsequently spawn macrosegregation in the form of A-segregates. With increasing solidification rate, however, thermosolutal interactions in the melt contribute to reducing the formation of channels and A-segregates. 61 refs., 14 figs., 1 tab.

13041 (DOE/ER/45095–5) **[Vibrational and electronic properties of clusters and ultrathin films]: Progress report, July 1, 1990–February 1, 1991.** Pennsylvania State Univ., University Park, PA (USA). [1991]. 3p. Sponsored by USDOE,. DOE Contract FG02-84ER45095. Order Number DE91007880. Source: OSTI; NTIS; GPO Dep.

This report briefly discusses the structural studies of bismuth clusters and carbon films performed during this reporting period. (FI)

13042 (DOE/ER/45188–T1) **[Fundamentals of hardening and ecohesion behavior in time-dependent cyclic deformation]: [Annual progress report].** Bassani, J.L. Pennsylvania Univ., Philadelphia, PA (USA). [1991]. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85ER45188. Order Number DE91008043. Source: OSTI; NTIS; GPO Dep.

The research carried out in the current DOE grant of the proposers had two purposes: (a) to develop an analytical characterization of simple crystal hardening under multiple slip deformations and to extend the constitutive models and experimentation developed for monotonic deformation to problems of cyclic deformation and (b) to explain certain phenomena of monotonic and cyclic deformation which depend on latent hardening, e.g. texture development, cyclic strain bursts, the stage 1 – stage 2 transition in fatigue crack propagation and the cyclic hardening behavior of polycrystals. In cyclic deformation, the main regime of interest was that of the plateau in the cyclic stress-strain curve of single crystals because long fatigue lines are associated with this regime. Progress is described in separate modelling and experimental segments in the next section (No. 2). Since it was realized that these results impinge strongly on the behavior of intercrystalline fracture, a proposal based on bicrystal experiments and analyses is then suggested. The proposed research is a study of the micromechanics of deformation and fracture processes at grain boundaries as affected by the structure of the boundary, slip geometry, hardening under multiple slip deformations, and the incompatibility of deformation at the boundary. A background and discussion of the study are offered in Sections (3) and (4) and the proposal proper in Section (5). 25 refs., 4 figs., 1 tab.

13043 (DOE/ER/45310–30) **Progress report on grain boundaries, February 15, 1990–October 15, 1990.** Balluffi, R.W.; Bristowe, P.D. Massachusetts Inst. of Tech., Cambridge, MA (USA). [1990]. 18p. Sponsored by USDOE,. DOE Contract FG02-87ER45310. Order Number DE91007932. Source: OSTI; NTIS; GPO Dep.

The present document is a progress report describing the work accomplished to date during the first year of our four-year grant (February 15, 1990–February 14, 1994) to study grain boundaries. The research was focused on the following four major efforts: study of the aromatic structure of grain boundaries by means of x-ray diffraction, transmission electro microscopy and computer modeling; study of grain boundary migration; study of short-circuit diffusion along grain boundaries; and the development of Thin-Film Deposition/Bonding Apparatus for the manufacture of high purity bicrystals.

13044 (DOE/ID/12847–1) **AISI direct steelmaking program: Annual technical report for year ending November 30, 1990.** Aukrust, E. American Iron and Steel Inst., Washington, DC (USA). 9 Jan 1991. 78p. Sponsored by USDOE,. DOE Contract FC07-89ID12847. Order Number DE91007163. Source: OSTI; NTIS; GPO Dep.

AISI with co-funding from DOE has initiated a research and development program aimed at the development of a new process for direct steelmaking, and the program is discussed in this document. The project is expected to cost about $30 million over a three-year period, with the government providing approximately 77 percent of the funds and AISI the balance. In contrast to current steelmaking processes which are largely open and batch, the direct steelmaking process would be closed and continuous. Further, it would use coal directly, thereby avoiding the need for coke ovens. The second year of the Direct Steelmaking Program (November 29, 1989, through November 28, 1990) was a year of significant accomplishment. The various research programs proceeded essentially on schedule and the pilot plant, the centerpiece of the program, was completed about three months behind schedule but began operation in almost a picture-perfect manner. This report presents the last years accomplishments.

13045 (ENEA-RT-INN–90-08) **Evaluation of rigid-plastic and elasto-plastic models in simulation of deep-drawing processes for simplified automotive particular.** Daneri, A.; Giambuzzi, S.; Toselli, G. ENEA, Bologna (Italy). Oct 1990. 9p. (CONF-9005322–1: 22nd international symposium on automotive technology & automation, Florence (Italy), 14 May 1990; RT/INN–90-08). Order Number DE91752920. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at 22nd international symposium on automotive technology & automation (Florence, 14-18 May 1990).

The FIAT (Italy) sheet deep-drawing process code for the automotive industry has already been adopted as an Italian benchmark for the evaluation of general purpose computer codes in sheet deep-drawing process simulations. This paper describes a study in which this code was utilized to point out the different responses of two constitutive law models for materials to be formed: the rigid-plastic model and the elasto-plastic model. The two models, as known, involve two different approaches to the whole problem schematization. For the first model, the specialized PLAFOM code and for the second one, the general purpose ABAQUS code were used. Several calculations were carried out without and with friction effect and the results were compared with experimental data.

13046 (ENEA-RT-INN–90-11) **2-D simulating of steel rolling by flow formulation.** Zucchini, A. ENEA, Casaccia (Italy). Centro Ricerche Energia. 1990. 28p. (RT/INN–90-11). Order Number DE91752915. Source: OSTI; NTIS (US Sales Only); INIS.

The finite element method (FEM) computer program PLAFOM, based on the rigid-plastic model of the 'flow formulation' and specifically designed for metal forming analysis, was used to simulate the 2-D rolling of a steel slab. The results of performance tests on a low carbon steel (with a Young's modulus of 20000 MPa, Poisson's ratio =0.3 and a 140 MPa yield stress), indicated that the calculated rolling forces for different reduction ratios and friction coefficient were comparable with those obtained by means of much larger programs (as ABAQUS and MARC); but PLAFOM required less computer time.

13047 (EUR–12845) **Acoustic emission measurements during cyclic fatigue of welded A533B plates containing defects.** Scruby, C.B. (United Kingdom Atomic Energy Authority, Harwell Lab. (UK)); Beesley, M.J.; Stacey, K.A.; Buttle, D.J. Commission of the European Communities, Luxembourg (Luxembourg). Apr 1990. 38p. Contract No. 3080-86-12 ELISPGB. Source: OSTI; NTIS (US Sales Only).

A series of A533B specimens, containing realistic intentional weld fabrication defects has been prepared and fatigue tested in the laboratory under conditions chosen to simulate those on the experimental Ispra pressure vessel. The defects have been validated by radiographic and ultrasonic NDT. Acoustic emission has

been recorded during the fatigue of these specimens under carefully controlled testing and monitoring conditions. Whereas previous work has either been in tensile loading of defective specimens or the fatigue of artificial cracks, this is the first study known to the authors on the fatigue of realistic weld fabrication defects under controlled laboratory conditions. The unique high bandwidth AEA Technology system has been used in conjunction with new 3-D software to locate the emission events from the defects, and thereby map out their growth. New source characterisation analysis software has been successfully used to distinguish between primary (crack advance) events and secondary (crack-related, but not directly due to advance) events during fatigue. The authors believe this is the first time that primary and secondary events have been recorded together from the fatigue of a steel specimen and the differentiated by radiation pattern analysis. The study has conclusively shown that during the dry fatigue of A533B steel weldments, the acoustic emission activity is dominated by secondary events associated with crack-face fretting, sticking and unsticking.

13048 (EUR–12888) **A microstructural investigation on the cracking of the Muhleberg reactor primary pipe CH1.** Bottelier, P.; Buscaglia, G.; Cambini, M.; Della Rossa, M. (ed.). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 37p. Source: OSTI; NTIS (US Sales Only).

The cracking of a Primary Pipe of the Muhleberg Reactor, was investigated by means of Optical Microscopy, Scanning Electron Microscopy and Electron Probe Microanalysis. The circumferential crack, extending almost 360^0 and 2-6 mm deep, started to propagate from the sharp edge of the counterbore. Since the crack initiation occurred at 45^0 circumferential location in the heat-affected zone near the weld, where intergranular precipitation of carbibdes has been found, it is concluded that the crack initiated primarily by stress-corrosion, as a consequence of residual stresses and weld sensitization. Taking into account that at other circumferential locations the crack was found to be outside the heat affected zone, it cannot be excluded that the propagation of the circumferential crack might be due also to fatigue corrosion. However, given the fact that the deepest cracking occurs in the heat affected zone the stress-corrosion mechanism seems to be predominant. The corrosive environment was likely originated or enhanced by sulphide ions, formed by dissolution of manganese sulphide inclusions in the crevices, as also found in previous investigations on low alloyed steels.

13049 (GKSS–90/E/31) **Crack blunting, cleavage fracture in transition area and stable crack growth - investigated using the nonlinear fracture mechanics method.** Heerens, J. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.); Technische Univ. Hamburg-Harburg, Hamburg (Germany, F.R.). Studiendekanat fuer Maschinenbau. 1990. 168p. (In German). Order Number DE91756679. Source: OSTI; NTIS (US Sales Only); INIS.

A procedure is developed which allows to estimate crack tip blunting using the stress-strain curve of the material and the J-integral. The second part deals with cleavage fracture in a quenched and tempered pressure vessel steel. It was found that within the ductile to brittle transition regime the fracture toughness is controlled by cleavage initiated at 'weak spots of the material' and by the normal stresses at the weak spots. In the last part of the paper the influence of specimen size on J-, Jm- and δ_5-R-curves for side grooved CT-specimens under fully plastic condition is investigated. In order to characterize constraint-effects the necking of the specimens was measured. For specimens having similar constraint the parameters Jm and δ_5 yielded size independent R-curves over substantial larger amounts of crack extension than the J-integral. (orig.) With 114 figs., 10 tabs.

13050 (INIS-mf–12796, pp. 233-236) **Effect of in-service decontamination on the corrosion behaviour of 18Cr10NIT type steels.** Jindrich, K. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Hamerska, H.; Kysela, J.; Vild, J.; Kopecky, J. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

The experiments were performed in a high pressure loop at a pressure of 20 MPa and a temperature of 280 degC using a H_3BO_3, KOH and NH_4OH solution. Following corrosion rate determination, the samples were decontaminated by seven different methods using decontamination solutions of different concentrations or by electrolysis. After the decontamination, the rate of corrosion was again determined. The corrosion loss of the samples was also measured. The corrosion rate was found to be identical prior to and after the decontamination. The corrosion layer after the decontamination was poorer in Fe on the expense of Cr. Compounds thus formed are more stable. The altered surface roughness of the steel after the decontamination was found to have a favourable effect on the radioactivity of the radioactive corrosion products trapped in the layer. (M.D.). 2 tabs., 2 refs.

13051 (INIS-SU–224(Vol.3), pp. 112) **Precise measurements of lattice constant of α-Fe whiskers.** Wokulska, K. (Silesian Univ., Katowice (Poland)); Grozwig, S.; Hartwig, J. AN SSSR, Moscow (USSR). 1989. 475p. (CONF-890859–: 12. European crystallographic meeting and international exhibition on apparatus and literature on crystallography, Moscow (USSR), 20-29 Aug 1989). In *12. European crystallographic meeting. V. 3: Collected abstracts.* Order Number DE91003068. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IRON-ALPHA/lattice parameters; ACCURACY; IRON-ALPHA; MEASURING METHODS; WHISKERS; X-RAY DIFFRACTION

13052 (Juel–2375) **Metallurgical considerations in the design of creep exposed, high temperature components for advanced power plants.** Schubert, F. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. Aug 1990. 215p. (In German). Order Number DE91756466. Source: OSTI; NTIS (US Sales Only); INIS.

Metallic components in advanced power generating plants are subjected to temperatures at which the material properties are significantly time-dependent, so that the creep properties become dominant for the design. In this investigation, methods by which such components are to be designed are given, taking into account metallurgical principles. Experimental structure mechanics testing of component related specimens carried out for representative loading conditions has confirmed the proposed methods. The determination of time-dependent design values is based on a scatterband evaluation of long-term testing data obtained for a number of different heats of a given alloy. The application of computer-based databank systems is recommendable. The description of the technically important secondary creep rate based on physical metallurgy principles can be obtained using the exponential relationship originally formulated by Norton, $\epsilon_{min} = k.\sigma^n$. The deformation of tubes observed under internal pressure with a superimposed static or cyclic tensile stress and a torsion loading can be adequately described with the derived, three-dimensional creep equation (Norton). This is also true for the description of creep ratcheting and creep buckling phenomena. By superimposing a cyclic stress, the average creep rate is increased in one of the principal deformation axes. This is also true for the creep crack growth rate. The Norton equation can be used to derive this type of deformation behaviour. (orig.).

13053 (Juel–2377) **Studies on phase kinetics of new superalloys.** Weisbrodt, A.; Penkalla, H.J.; Schubert, F.; Nickel, H. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.). Aug 1990. 107p. (In German). Order Number DE91754840. Source: OSTI; NTIS (US Sales Only); INIS.

Dissertation submitted by A. Weisbrodt.

At the development of new ODS (Oxide-Dispersion-Strengthened) alloys for components being exposed to hot-gas temperatures nickel-base alloys and ODS alloys have been investigated. The experimental work mainly referred to phase investigations of thermally loaded samples. The addition of alloying elements will have a decisive influence on the γ'-phase fraction, γ'-lattice parameter, the morphology as well as the coarsening behaviour of the γ'-phase under temperature load. The main characteristics of ODS alloys are Y,Al-mixed oxides and microstructural

inhomogenities. As for MA6000 a Time-Temperature-Precipitation diagram has been elaborated. By means of the improved computer programme PHASCALC for phase and N_v (= average electron vacancy concentration) - value calculation many microstructural parameters such as the γ/γ'-misfit, the solution of the γ'-phase and melting temperatures can be determined. Tensile tests made at temperatures above 900deg C have shown that the strengthening parameters are dependent on alloy composition, temperature conditions, γ'-phase fraction and oxide dispersion content. (orig.).

13054 (Juel–2379) **A new technique for precise measurement of thermal conductivity of metals at normal and high temperatures.** Binkele, L. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. Sep 1990. 82p. (In German). Order Number DE91754841. Source: OSTI; NTIS (US Sales Only); INIS.

Theoretical and experimental investigations on a new measuring technique are described; a technique similar to the well known Kohlrausch measuring technique, which is characterized by direct electrical sample heating. Subject of the investigations is a cylindrical metallic sample, 5 mm thick and 200 mm in length, which is positioned vertically between water-cooled clamps in a vacuum container. The sample can be heated using two simultaneously operating current sources, a 50 Hz-source for axial flow (main heating) as well as a 200 kHz-induction source for generating eddy currents in two short regions above and below the sample centre (additional heating). By using two heating sources different symmetrical temperature profiles in a central eddy-current-free area of about ± 10mm can be produced for any given central sample temperature. The last chapter contains thermal conductivity and electrical resistivity measuring curves for Pt, W, Fe, Ni, Ag, Al, Mg, Ir, Ru, Re, Ho and Y in the temperature range 273 to 1500 K representative of all the metals and alloys investigated. In cases where comparisons with published precise conductivity data, established by other measuring techniques in restricted temperature ranges, were posible, the new measuring method is greatly supported (in the case of Pt, W, Ni, Ag, Al). For the Metals Ir, Ru, Re, Ho and Y high temperature thermal conductivity data are given for the first time. (orig./MM).

13055 (Juel–2381) **Diffusion welding of ODS alloys using HIP-techniques.** Hammelmann, K.H.; Stoever, D.; Buchkremer, H.P.; Leyers, H.J.; Serpekian, T. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Angewandte Werkstofforschung. Sep 1990. 38p. (In German). Order Number DE91754835. Source: OSTI; NTIS (US Sales Only); INIS.

The ODS materials (Oxide Dispersion Strengthened) Inconel MA754, Inconel MA6000 and Incoloy MA956 as well as the alloy Incoloy 800H were examined for their diffusion weldability using HIP techniques. Two test specimens of the same materials as well as combinations of an ODS partner material and Incoloy 800H were joined with each other. A good diffusion bond is characterized by the strength of the bonding zone. In order to determine the tensile strength, yield strength and elongation, two identical specimens (same combination under the same HIP conditions) were tested to rupture in a tensile test device at room temperature (RT) and 800deg C. It was found that several specimens failed in the region of the joint. This was mainly due to the fact that the HIP pressure adjusted at 40 MPa was too low, but may also be attributed to other causes which still remain to be clarified. For example, the influence of the specimen surface condition was not known. The second experimental phase therefore served to selectively vary the roughness of the bond surface. Gastight encapsulation of the composite material in the joint is required for diffusion bonding by means of HIP. In addition to the conventional method of stainless steel encapsulation, an LPPS (Low Pressure Plasma Spray) encapsulated of the joint was also tested. (orig./MM).

13056 (KC-PUB–89-01-E) **Cracks in boiler plants.** Jansen, P. Korrosionscentralen, Broendby (Denmark). 1989. 32p. Order Number DE91752953. Source: OSTI; NTIS (US Sales Only).

This report describes commonly found cracking phenomenons appearing in steam boilers of all designs and pressures which is illustrated with examples of cracks occurring in boiler plants. All the examples mentioned are taken from the large number of boiler damages, in boilers of many types and sizes which the Danish Corrosion Centre has examined over the years. In most cases, when combining the results of the metallurgical examination with information about the construction and operation of the plant, it has been possible to point out the actual cause of the damage so that new incidents can be prevented. The report is based on a paper presented at the Danish Metallurgical Society Winter Meeting 1980. In connection with the English version the content has been revised and extended in 1989. (author).

13057 (KFK–4734) **Summarizing report on research and development activities in 1989, KfK Institute of Materials and Solid State Research.** Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung. Mar 1990. 55p. (In German). Order Number DE91759518. Source: OSTI; NTIS (US Sales Only); INIS.

This annual report of the Institute for Materials and Solid State Research (IMF) summarizes the institute's activities in the following fields and projects: (1) Fast Breeder project, PSB. Work here concentrated on core, cladding, and structural materials, safety analyses, and core monitoring. (2) Nuclear Fusion Project, PKF, (structural materials, superconducting magnets, blanket development). (3) Radioactive Waste Processing (PWA) and waste management (analysis of residues from dissolution of LWR fuels in nitric acid; materials testing of an austenitic steel in HNO_3). (4) Ultimate disposal of radioactive waste (corrosive testing of materials for HAW containers). (5) Environment and safety (mechanical and chemical behaviour of LWR fuel elements at high temperatures). (6) Materials and solid state research (high-temperature materials, ceramics, superconducting materials). An annex to the annual report presents the bibliographic data of all reports and other publications written by members of the institute. (MM).

13058 (KFK–4767) **Creep and creep-rupture tests on the EFR-structure-material 316 L(N) DIN 1.4909.** Schirra, M.; Heger, S. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheitsforschung. Sep 1990. 65p. (In German). Order Number DE91754837. Source: OSTI; NTIS (US Sales Only); INIS.

The tensile properties in the temperature range from RT-850deg C and the creep and creep-rupture behaviour from 500-700deg C were determined at the structure material of the planned European Fast Reactor (EFR). The test program encompassed two melts from a german and french manufacturer with rupture times until 16.000 h. The test results are added with datas from a melt of the fusion program, that has the same chemical composition. All test results were compared with long-term creep results from the commercial type 1.4919 resp. AISI 316 from German, Japanese and American laboratories. In comparison with the Mo-free structural material 1.4948 (AISI 304), the 1.4909 type shows markable higher creep-strength values and a more creep resistant behaviour. The metallographic examinations demonstrate the complex precipitation behaviour and the creep-resist structure in connection with high ductility and transcrystalline fracture mode in the temperature range from 500-700deg C. (orig.).

13059 (LA-UR–91-610) **Deformation substructures induced by high-rate deformation.** Gray, G.T. III. Los Alamos National Lab., NM (USA). [1991]. 17p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910202–6: Annual meeting and exhibition of the Minerals, Metals and Materials Society, New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91008595. Source: OSTI; NTIS; GPO Dep.

The influence of increasing strain on the deformation substructures in metals and alloys which deform predominately by slip is very similar to that seen following quasi-static deformation at increasingly lower temperatures or due to a decrease in stacking fault energy (γ_{sf}). For constant strain, deformation at higher rates: (1) produces more uniform dislocation distributions for the same amount of strain, (2) hinders dislocation cell formation, (3) decreases the cell size, and (4) increases misorientaion with more dislocations trapped within the cell interiors. The suppression of thermally-activated dislocation processes in this regime, added to high temperature and strain-rate sensitivity of the yield stress exhibited by many materials, can lead to stresses high enough to nucleate and grow deformation twins even in high stacking fault

energy FCC metals such as copper and Al-4.8 wt % Mg. In addition, substructures formed under high-rate conditions differ from those formed under low-rate conditions due to the suppression of dynamic recovery process. Finally, in high-rate deformation such as shock loading, the subsonic restriction on dislocation motion leads to higher dislocation and point defect generation rates, resulting in enhanced hardening when compared to materials deformed to equivalent strains at quasi-static rates. In this paper examples of the deformation substructure evolution observed in aluminum, copper, Ni_3Al, iron, Ti-6Al-4V, and TiAl at high and shock-loading strain rates will be presented and compared to that seen following low-rate deformation paths. 41 refs., 15 figs.

13060 (LBL–29614) **Superplastic creep of eutectic tin-lead solder joints.** Mei, Z. (Lawrence Berkeley Lab., CA (USA)); Hansen, R.; Morris, J.W. Jr.; Shine, M.C. Lawrence Berkeley Lab., CA (USA). Sep 1990. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-901194–14: American Society of Mechanical Engineers (ASME) winter annual meeting, Dallas, TX (USA), 25-30 Nov 1990). Order Number DE91009074. Source: OSTI; NTIS; GPO Dep.

Creep behavior of air-cooled and liquid nitrogen-quenched soldered joints of 60/40 Sn-Pb at 65°C has been studied. The stress exponent, n, in the power law, $\dot{\gamma}$ (steady state strain rate) $\propto \sigma^n$ (applied stress), changes from a value of about 6 to values of 2 or 3, as $\dot{\gamma}$ decreases below 10^{-4} in/in per second. This result, combined with the authors' previous stepped load creep test results, indicates a transition in creep deformation mechanism from conventional dislocation climbing to superplastic grain boundary sliding. The superplastic creep of the soldered joints is ascribed to their non-lamellar microstructure due to their fast cooling rate. During creep deformation, recrystallization of the soldered joints occurs, resulting in a softening phenomenon. 30 refs., 12 figs.

13061 (LBL–29840) **On the role of mass-transport in electrodeposition of nickel-iron alloys.** Hessami, S.; Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Nov 1990. 228p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. Order Number DE91009090. Source: OSTI; NTIS; GPO Dep.

Thesis submitted by S. Hessami.

Despite the extensive use of nickel-iron, the mechanism of codeposition is not well understood. The interactions occurring during codeposition are such that nickel deposition is inhibited in the presence of iron, and the resulting alloy deposit has a much higher iron to nickel ratio than the electrolyte. This type of interactive deposition is an example of what has been termed anomalous codeposition, which is also used in describing electrodeposition of iron group elements (iron, cobalt, and nickel) with each other, or with zinc, tin, lead, and cadmium. In Chapter 2 of this thesis, a critical review of the literature is presented. Various interpretations and proposed mechanisms for the anomalous deposition of the iron-group alloys, particularly nickel-iron, is discussed. The major objectives of this review are to provide unambiguous definitions for various codeposition schemes, including the anomalous deposition itself, reflect on some of the more widely accepted hypothesis describing this phenomenon, and summarize the more recent results of other investigators in the field. To elucidate the electrodeposition mechanism of magnetic alloys, a mathematical model is developed in Chapter 3. The model is applied to a rotating disk electrode system, with well understood hydrodynamics, and incorporates homogeneous reactions of metal-hydroxide complexes. In Chapter 4, the model is further used to investigate the effect of buffering agents which are commonly used in electroplating baths. Our understanding of the mechanism of electrode processes depends on the accurate measurement of these concentrations. The interfacial value of pH is particularly important for electrodeposition of the iron-group alloys. In Chapters 5 and 6, an in-situ nonintrusive technique for surface pH measurement is investigated by theoretical and experimental methods.

13062 (LBL–29924) **Levelling of microprofiles in electrodeposition.** Jordan, K.G. Lawrence Berkeley Lab., CA (USA). Dec 1990. 261p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009083. Source: OSTI; NTIS; GPO Dep.

This dissertation addresses current distribution phenomena in the smoothing of advancing and receding microprofiles during electrodeposition in the following areas: levelling in the presence of inhibitors, levelling in the presence of corrosive agents, and levelling caused by periodic current reversal. These phenomena are relevant to many commercial electrodeposition processes. Theoretical analysis of moving boundaries in electrodeposition is addressed, focusing on the levelling of microscopic surface contours. The literature relevant to the solution of current distribution problems is reviewed. Convection of inhibitors to the depth of trenches is evaluated using the finite element method, and characterized as a function of Reynolds number, notch angle, and depth. Secondary flows are shown to noticeably enhance transport into microscopic trenches only at high Peclet numbers, i.e. at very high flow velocities. The boundary element method (BEM) is used to analyze levelling caused by inhibitors consumed at the transport limiting rate during electrodeposition. It is predicted that (1) better levelling performance can be obtained if the microscopic surface waviness is oriented perpendicular to the convective flow, and (2) for surface roughness oriented parallel to the flow, there is an optimum boundary layer thickness, or flux of additive, which results in superior levelling performance. Profilometry and photomicrography is applied to obtain the current distribution, current efficiency and levelling performance on novel microprofiled electrodes for two orientations with respect to the fluid flow during nickel electrodeposition in the presence of coumarin. Slightly better levelling occurs in flows transverse to grooves, and the deposit thickness increases in the flow direction. It is concluded that coumarin acts by simultaneously lowering the current efficiency, and blocking metal deposition. 331 refs., 86 figs., 8 tabs.

13063 (LBL–29960) **Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture.** Shaffer, S.J. Lawrence Berkeley Lab., CA (USA). Dec 1990. 108p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. Order Number DE91009113. Source: OSTI; NTIS; GPO Dep.

The role of texture (preferred crystallographic orientation) of the zinc coating in friction of electrogalvanized steels is investigated. Samples of sharp (1) basal (fine grained and course grained), (2) low angle pyramid, (3) high angle pyramid, and, achieved through the addition of cadmium to the electrolyte, (4) prism textures, which were produced via laboratory electrodeposition, were friction tested using both a drawbead simulator (DBS) and a one-sided straight stripdraw test. It was found that the initial texture of the samples did not influence friction through the zinc's anisotropic response to loading. However the fine grained basal samples did exhibit unusually high friction, which was attributed to a rapid increase in contact area fraction due to easy shearing of the individual zinc crystallites. In an opposite manner, the prism textured samples exhibited exceptionally low friction as a result of low contact area fraction, which was attributed to a combination of higher hardness and a rougher topography. It is concluded that those factors within the coating which dictate contact area fraction control friction. The two most prominent are surface roughness and hardness. It was found through pole figure measurements that large changes in the texture of the zinc, restricted to a depth of about 1 μm, take place as a result of friction testing. Progression toward a common texture is the result of plastic deformation, with strong evidence of recrystallization. Calculations of resolved shear stresses for slip on the basal system corroborated this through predicted difficulty in deformation for orientations whose basal poles lie along a trace perpendicular to the macroscopic shearing direction. Finally, techniques for rapid in-sheet-plane texture measurement and for deconvolution of textures as a function of depth and contact area fraction are proposed.

13064 (LIU-TEK-LIC–90-45) **Two-dimensional calculation of quench stresses in steel.** Linkoeping Studies in Science and Technology. Jaervstraat, N. Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering. 4 Sep 1990. 86p. Order Number DE91753042. Source: OSTI; NTIS (US Sales Only).

During the quenching of steel, stresses are introduced by thermal gradients via volume expansion and transformation strains. In addition, conventional and transformation plasticity influence the stresses by accommodation that introduces a permanent geometric misfit. This misfit along with any inhomogeneous transformation

strains, are the governing factors of the residual stress state. The main purpose of the work in this thesis is to create the means for predicting the stresses in any two-dimensional body during a quench. To this end, a computational package TRAST has been developed as a system of subroutines for use with ABAQUS, a commercial FEM program. The first paper describes the algorithms used in TRAST, and shows a simple application example. The second paper utilizes TRAST to investigate the effects on residual stress prediction of some different models of transformation plasticity. The third paper utilizes TRAST to investigate the effects on residual stress predictions of variations in the surface heat flux due to a steam film that develops asymmetrically along a cylindrical specimen. (author).

13065 (MEA–2221) **Sample preparation, irradiation, and testing of 304 stainless steel specimens: Final report.** Hawthorne, J.R. (Materials Engineering Associates, Inc., Lanham, MD (USA)); Hiser, A.L.; Menke, B.H.; Cullen, W.H.; Loss, F.J. Savannah River Lab., Aiken, SC (USA); Materials Engineering Associates, Inc., Lanham, MD (USA). Aug 1987. 291p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Contract AX-681732. (MEA–87-05). Order Number DE91009373. Source: OSTI; NTIS; INIS; GPO Dep.

This study investigated the Charpy V-notch (C_v), tensile, and elastic-plastic (J-R curve) properties of AISI 300 series stainless steel plate, weld, and weld heat-affected zone (HAZ) components of commercial production weldments. The weldments were removed from the R-reactor at the Savannah River Plant. (SRP) and were in the form of 406-mm diameter, 12.7-mm wall thickness pipe sections fabricated in the 1950's. Test matrices were designed to yield information on fracture resistance for use in systems integrity and safety assessments. Tensile and J-R curve properties were determined for the unirradiated condition for both slow loading (quasi-static) conditions and a rapid loading condition simulating a seismic event. C_v and tensile properties were determined for the unirradiated condition and for an irradiated condition which received a fluence of 1.1×10^{20} n/cm^2 $E > 0.1$ MeV at 120°C. Fractographic examinations were made of unirradiated and irradiated C_v specimens.

13066 (ORNL/Sub–89-SA187/01) **Literature search update: Fireside corrosion testing of candidate superheater tube alloys, coatings, and claddings.** Van Weele, S.; Blough, J.L. Oak Ridge National Lab., TN (USA); Foster Wheeler Development Corp., Livingston, NJ (USA). Sep 1990. 43p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91008551. Source: OSTI; NTIS; GPO Dep.

Supercritical units have required superheaters and reheaters constructed of expensive high-chromium/high-nickel alloys, and they have been limited to burning coals with low corrosivity. Several high-chromium alloys, such as Type 310 and CR35A, hold promise as claddings for tubes in highly corrosive conditions. Modified lower-alloy steels-HR3C and CR30A, for example – with much greater corrosion resistance and creep-rupture strength are being developed. The beneficial effects of chromium have been demonstrated during laboratory experiments and in-situ probe trails. Corrosion resistance of various alloys subjected to coal ash with a wide range of sulfur and alkali levels correlates well with chromium content. Molybdenum has been found detrimental in several studies. Both beneficial and deleterious effects have been reported for aluminum, silicon, manganese, and various rare earths. Corrosion-resistant coatings have shown promise in both laboratory corrosion studies and in-situ tests. Plasma-sprayed coatings of magnesium zirconate are almost impervious to corrosive attack from the higher melting compound that solidifies in the pores of the coating. The performance of both sprayed and diffusion coatings is highly dependent upon the method of application, the length of the test, and the aggressiveness of the alkali sulfate. The laboratory coal-ash corrosion retort/field corrosion probe combination has proved valuable for coal-ash corrosion research. The laboratory test provides the accelerated screening device for alloy, temperature, and ash/gas constituent evaluation. The coal-ash corrosion probes exposed in operating utility boilers provide combined variables, complex gas/solids, heat-transfer conditions, which are very difficult to totally simulate in the laboratory. 32 refs., 29 figs., 14 tabs.

13067 (SAND–90-3143C) **CO_2 induced inhibition of the localized corrosion of aluminum, Al-0.5% Cu, and Al-2% Cu in dilute HF solution.** Scully, J.R. (Virginia Univ., Charlottesville, VA (USA). Dept. of Materials Science); Peebles, D.E. Sandia National Labs., Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910552–1: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91005312. Source: OSTI; NTIS; GPO Dep.

This study presents work on corrosion of aluminum, Al-.5% Cu, and Al-2% Cu. Electrochemical tests were performed in dilute HF solutions both with and without CO_2 sparging. It is suggested that CO_2 or its reaction products interact with the passive film so that exposure of Cu in the oxide-solution interface is minimized. CO_2 is investigated as a corrosion inhibitor. 4 refs. (JDL)

13068 (SAND–90-7035) **High temperature deformation of silicon.** Ast, D.G. (Cornell Univ., Ithaca, NY (USA)); Perreault, G.C.; Hyland, S.L. Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Jan 1991. 155p. Sponsored by Nat. DOE Contract AC04-76DP00789. GRANT ECS8619049. Order Number DE91009102. Source: OSTI; NTIS; GPO Dep.

This work is concerned with characterizing, observing, and exploring the origins of a silicon crystalline defect's electrical properties. These goals are accomplished by unique applications of the electron-beam-induced current (EBIC) technique. Bulk silicon solar cell properties are correlated with EBIC at low accelerating voltage (LAV-EBIC) and high accelerating voltage (HAV-EBIC). HAV-EBIC currents were related linearly to the short-circuit current density, conversion efficiency, and dislocation density, but LAV-EBIC currents were found to be independent of the same properties. The difference in probing depth was used to explain the discrepancy. EBIC and transmission electron microscopy (TEM) were combined into one scanning transmission electron microscope (STEM) to unambiguously correlate electrical activity with defect structure. This technique is successfully applied to defects in polycrystalline silicon, but the complexity and variety of general silicon defects made this approach unsuitable for uncovering the origins of a defect's electrical activity. These origins were investigated by welding together two float-zone silicon wafers to form twist boundaries. These boundaries are composed of a square array of screw dislocations of sufficient number and purity to separate impurity effects from the intrinsic electrical activity. Applying the Kittler and Seifert model, the silicon screw dislocations were estimated to have between 0.3 and 0.5 recombination sites per Burgers vector. It was subsequently concluded that kinks and jogs were responsible for screw dislocation electrical recombination. 82 refs., 23 figs.

13069 (SAND–91-0011C) **EBIC [electron beam induced current] contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations.** Zhou, T.Q. (North Carolina State Univ., Raleigh, NC (USA). Dept. of Materials Science and Engineering); Buczkowski, A.; Radzimski, Z.J.; Rozgonyi, G.A.; Seager, C.H.; Panitz, J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910552–8: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91006967. Source: OSTI; NTIS; GPO Dep.

The electrical activity of as-grown and intentionally decorated misfit dislocations in an epitaxial Si/Si(Ge) heterostructure was examined using the electron beam induced current (EBIC) technique in a scanning electron microscope. Misfit dislocations, which were not visible initially, were subsequently activated either by an unknown processing contaminant or a backside metallic impurity. Passivation of these contaminated dislocations was then studied using low energy deuterium ion implantation in a Kaufman ion source. EBIC results show that the recombination activity of the decorated misfit dislocations was dramatically reduced by the deuterium treatment. Although a front side passivation treatment was more effective than a backside treatment, a surface ion bombardment damage problem is still evident. 5 refs., 3 figs.

13070 (SAND–91-0505C) **Surface cleaning by laser ablation.** Peebles, H.C.; Creager, N.A.; Peebles, D.E. Sandia National

Labs., Albuquerque, NM (USA). [1991]. 14p. Sponsored by US-DOE.. DOE Contract AC04-76DP00789. (CONF-910279–12: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991). Order Number DE91009189. Source: OSTI; NTIS; GPO Dep.

Nd:YAG laser cleaning of metal oxides from 304L stainless steel surfaces has been characterized. Thin chromium oxide films can be completely removed from the surface using a single 10 nsec pulse of laser radiation with an average surface irradiance greater than 120 MW/cm^2. Laser etching of thicker iron oxide films exhibit a self-limiting effect that prevents overetching into the stainless steel substrate. 8 figs.

13071 (SIEMENS-KWU-TWC–2244/88) **Influence of residual compression stresses on the stress corrosion cracking behaviour of turbine rotor disc material. Final report.** David, W. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Nov 1988. 40p. (In German, English). Contract COST 505-D 3;BMFT 03K05055. Order Number DE91754622. Source: OSTI; NTIS (US Sales Only); INIS.

In this project the influence of residual compression stresses on the stress corrosion cracking behaviour of the turbine disc steel 26 NiCrMoV 14 5 ($Rp_{0.2}$ = 850 N/mm^2) was investigated. The residual compression stresses were produced by shot peening and rolling. Shot peening results in residual compression stresses of -500 N/mm^2 in the surface. In a depth from 600 μm there still exist stresses from -100 N/mm^2. CERT experiments with shot peened and unpeened specimens under hydrogen charging conditions were performed to see, whether residual compression stresses prevent the diffusion of hydrogen into the metal. This could not be established with these experimental parameters. Stress corrosion tests were carried out with shot peened tensile specimens and modified CT 2 specimens. The shot peened cylindrical specimens dependent on the stress level, have a time to failure which is ten times and more longer in 35% NaOH + 3,5% NaCl solution in comparison to untreated specimens. The CT2 specimens had a shot peened surface and a rolled bore hole of 20 mm. The residual compression stresses in the bore hole are produced by rolling in tangential direction. Compression stresses in the surface of -400 N/mm^2 can be realized, with a maximum of -600 N/mm^2 in a depth of 600 μm. In a depth of 1500μm there still exist stresses of -100 N/mm^2. The CT 2 specimens were charged with hydrogen and also testet in 35% NaOH + 3,3% NaCl solution. Cracking occurred within 200 test hours at the bores of the samples which were not rolled. Crack initiation was not found in the bores of the samples which were rolled. The results show, that residual compression stresses in the critical surface regions can prevent stress corrosion cracking on turbine disks. (orig./MM) With 24 annexes.

13072 (SIEMENS-KWU-TWC–2246/88) **Corrosion behaviour of austenitic ferritic steel X 3 CrMnNiMoN 25 6 4 under conditions similar to operating conditions. Final report.** David, W. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Nov 1988. 37p. (In German, English). Contract COST 505-D 28:BMFT 03K05044. Order Number DE91754620. Source: OSTI; NTIS (US Sales Only); INIS.

Corrosion tests on the duplex steel X3 CrMnNiMoN 25 6 4 are conducted, whichis a candidate material for steam turbine blades. In 0,01 NaCl, 80deg C, pH 3 and 7 a pitting corrosion potential of 575 mV_{SHE} was measured. Under crevice corrosion conditions the potential decreaseds to 400 mV_{SHE} in the solution with pH 7 and to 350 mV_{SHE} in the solution with pH 3. With the blade and the bar material a fatigue strength of 250 $\pm$ 250 N/mm^2 was reached in air. Under corrosio conditions in 22% NaCl, 80deg C, oxygen saturated, the corrosion fatigue limit from bar material decreased to 250 $\pm$ 190 N/mm^2 (pH 7), resp. to 250 $\pm$ 130 N/mm^2 (pH 3) and from blade material to 250 $\pm$ 170 N/mm^2 (pH 7) and 250 $\pm$ 70 N/mm^2 (pH 3). There exists a great influence of surface machining on the corrosion fatigue limit. Stress corrosion tests were performed in 22% NaCl- and 0,01 n NaCl-solutions, 80deg C, oxygen saturated, pH 3 and 7. On bar material cracks occurred only in the concentrated solution with pH 3 in some cases, whereas the blade material cracked in both solutions with pH 3. Metallographic examinations do not show typical SCC but pitting or crevice corrosion and ductile fracture. The duplex steel X3 CrNiMoN 25 6 4 has indeed better corrosion properties than the martensitic 13%-Cr steels but also a lower strength. (orig./MM) With 24 annexes.

13073 (SIEMENS-KWU-TWM–0405/89) **Materials examination on steam turbine components for life time predictions. Final report.** Keienburg, K.H.; Hajdu, T. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 28 Feb 1989. 32p. (In German, English). Contract COST 505-D 13:BMFT 03K05099. Order Number DE91754621. Source: OSTI; NTIS (US Sales Only); INIS.

For life time prediction of service exposed steam turbine components, realistic material properties are needed. Besides special material examinations carried out on the component itself or on limited number of specimens taken from the component, a brought basic knowledge can be derived from through-going material examinations on a retired service exposed component. In this COST-Project a MP disk type rotor made from 1% CrMoV steel early in the sixties was examined in respect to its characteristic material data after 123.280 h, 122 cold and warm starts and a medium steam turbine inlet temperature of about 554deg C. The material examinations were together with other COST partners concentrated on the disks 1, 6 and 14 with a nominal temperature of 560, 480 and 318deg C. The achieved test results are typical for a good rotor manufactured early in the sixties. The measured properties characterize the difference between the rim and core as well as the influence of the different thermal history of the different parts of the rotor. No hints were found in respect to creep or low cycle fatigue damage. The achieved curves for the creep rupture, low cycle fatigue and fatigue crack growth and the results for the toughness behaviour are typical and will build the fundament for the total evaluation of all results in respect to the theoretical life time prediction analysis which will be carried out by the COST partner UK15. (orig.) With 17 annexes.

13074 (SIEMENS-KWU-TWM–1116/89) **Development of improved HP/IP rotor material 2% CrMoNiWV (23 CrMoNiWV 88). Final report.** Wiemann, W. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe. 1989. 40p. Contract COST 505/D 32. Order Number DE91754713. Source: OSTI; NTIS (US Sales Only); INIS.

The new 2% CrMoNiWV steel has a sufficient strength level, a very good creep (rupture) behaviour and an excellent toughness behaviour for a creep resistant steel. Even after long time high temperature exposure the toughness degradation is so small that it is still better than this of best 1% CrMo(Ni)V steels. The fatigue behaviour is well comparable to this of 1% CrMo(Ni)V. The 2% CrMoNiWV steel has the capability to substitute the traditional 1% CrMo(Ni)V. (orig.) With 26 annexes.

13075 (SIEMENS-KWU-TWM–1339/89) **Crack growth and fracture behaviour of stress corrosion cracks of turbine generator steels. Final report.** Berger; Vahle. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 30 Jun 1989. 47p. Contract BMFT 03K05142:COST 505/D5. Order Number DE91759512. Source: OSTI; NTIS (US Sales Only); INIS.

The object of this investigation was the quantifying of the behaviour of cracks which were induced during service under corrosive media. To investigate the influence of stress corrosion crack configurations on stress intensity factor, six different test materials from 2 and 3.5% NiCrMoV and 2% Cr/1% Ni steels were chosen. The stress corrosion cracks were induced at wedge loaded compact tension specimens in a corrosive media in the laboratory. Fracture mechanics tests as well as fatigue crack growth tests were performed at these specimens. All stress corrosion cracks have an intercrystalline path and a crack length longer than 1 mm; they are multiple and have branched cracks tips. The fracture mechanics tests at these stress corrosion cracks induced in the laboratory and during service of components show that their stress intensity factor

is 30 to 70% smaller than the stress intensity factor calculated for single straight cracks too. Theoretical calculations arrived to the same results. Crack initiation and growth behaviour under cyclic loading starting from these stress corrosion cracks results in that the load or the stress intensity range ΔK has to be increased three times larger than the ΔK-threshold value to induce crack initiation. The crack growth velocity influenced by multiple crack tips and multiple growing cracks from these crack tips is much lower than the crack growth velocity of a normal fatigue crack (one crack tip). (orig./MM) With 32 figs.

13076 (SIEMENS-KWU-TWM–2429/88) **Long-term behaviour of welded specimens with optimized weld metals for high-temperature resistant cast steel. Final report.** Niel, K. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. 77p. (In German). Contract COST 505-D 16:BMFT 03K05131. Order Number DE91754623. Source: OSTI; NTIS (US Sales Only); INIS.

The most important creep resisting cast steel grade in Europe is the GS-17 CrMoV511. The properties of weldments of this steel grade, especially the long term properties in former times did not reach the scatterband of base metal, due to the low C-content of filler-metals. In this project four SA-fabrication-welded materials with optimized weld metal (C-content > 0.1%) and different post-weld heat treatments have been manufactured. After testing mechanical properties and chemical analysis long term creep rupture tests at 530 and 560deg C on welded joints up to 25.000 h as well as impact toughness tests on filler metal before and after long term exposure (20.000 h at 530deg C) have been carried out. The sum of testing time of all creep rupture specimens is > 300.000 h. Test results have shown: 1. Due to the higher C-content mechanical properties of the welded joints are better than those of former filler-metal with lower C-contents. 2. Higher annealing temperature gives better results in short term as well as in long term behaviour. 3. Creep rupture points of the welded joints up to now were in the scatterband near the lower bound of of the base metal. 4. The position of rupture in creep rupture specimens after long testing times are preferred in the heat affected zone of base metal. 5. The impact toughness after long term exposure is satisfying. (orig./MM) With 55 annexes.

13077 (SVF–376) **Erosion resistance of some ceramic and metallic materials in a simulated fluidized bed environment.** Engman, U. (Studsvik Energy, Nykoeping (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Aug 1990. 57p. (In Swedish). (STUDSVIK-EX–89-52). Order Number DE91753059. Source: OSTI; NTIS (US Sales Only).

Eight different ceramics, comprising fired and monolitic refractories and special ceramics, have been erosion tested at 800 degrees C. Large differences, a factor of 25, in erosion resistance between the materials were found. A high content of SiC is beneficial. The best ceramic material was a silicon infiltrated silicon carbide. Eight different metallic materials have been tested, both as solid metals and welded or sprayed coatings. These alloys are used either for their abrasion resistance or their corrosion resistance. Quite small differences in erosion resistance, within a factor of 2, were found. The best material was a welded Stellite coating. The metals had in general a lower erosion rate than the ceramics at 90 degrees impact angle. The results were more comparable at 30 degrees impact angle.

13078 (UCRL-ID–106142) **Weldability of AerMet 100.** Kautz, D.D.; Hoffman, D.E.; Westrich, C.N. Lawrence Livermore National Lab., CA (USA). Jan 1991. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008626. Source: OSTI; NTIS; GPO Dep.

Several test welds were made on AerMet 100 alloy. Both electron beam and pulsed Nd:YAG laser beam welding processes were used to make the welds. All welds were satisfactory, with no cracking or porosity noted in weld cross-sections. 2 refs., 6 figs.

13079 (UCRL-JC–104591) **Interplay between local environment effect and electronic structure properties in close packed structures.** Turchi, P.E.A. Lawrence Livermore National Lab., CA (USA). 16 Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-901105–98: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008506. Source: OSTI; NTIS; GPO Dep.

Within a tight binding framework, the interplay between local atomic arrangement, orbital directionality and phase stability properties is discussed for a series of tetrahedrally chose packed (tcp) structures. The common features which characterize the local densities of states of top phases can be explained by a moment analysis up to fourth order terms. On the contary it is shown that structural energy differences between simple and top crystalline structures requires the knowledge of at least the fifth order moments, a fact which has been underestimated in the past. Finally, the relative stability of various representative geometries, including the ones of simple crystalline structures is examined as a function of the number of valence electrons. 12 refs., 2 figs., 2 tabs.

13080 (UCRL-JC–104594) **First principles calculation of phase stability of high temperature intermetallic alloys.** Mikalopas, J.; Sterne, P.A.; Sluiter, M.; Turchi, P.E.A. Lawrence Livermore National Lab., CA (USA). 18 Dec 1990. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901105–100: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008570. Source: OSTI; NTIS; GPO Dep.

One way to calculate the coherent phase diagram of an alloy based on first principles methods is to compute the ground state total energy for various ordered configurations, from which many-body interactions can be calculated and employed in a thermodynamic model. If the Connolly and Williams method (CWM) is used to extract the many-body interactions from the calculated total energies, the resulting many-body interactions can exhibit a strong dependence on the choice of ordered configurations and multi-site clusters, and the accuracy and convergence of the CWM energy expansion is not assured. To overcome this difficulty, a successful systematic method for implementing the CWM is proposed. This approach is applied to a study of the fcc-based Ni-V and Pd-V substitutional alloys and these interaction parameters together with the cluster variation method (CVM) are used to calculate phase diagrams. 10 refs., 4 figs., 1 tab.

13081 (UCRL-JC–106136) **Molecular dynamics of tweed and ω-phase instabilities in B2 $Ni_{62.5}Al_{37.5}$ alloys.** Becquart, C. (Connecticut Univ., Storrs, CT (USA). Dept. of Metallurgy); Clapp, P.C.; Rifkin, J.A. Lawrence Livermore National Lab., CA (USA). Dec 1990. 7p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901105–102: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008731. Source: OSTI; NTIS; GPO Dep.

Diffuse TEM and x-ray data has been reported by several research groups that has been interpreted in terms of both tweed and ω-phase instabilities. Computer simulations of 1024 atom arrays were run at various temperatures using the Voter-Chen Embedded Atom Method (EAM) interactions. If the extra Ni atoms were placed at random on the Al sub-lattice of the B2 structure, at low temperatures both ⟨110⟩* and ⟨112⟩* diffuse streaking were observed in reciprocal lattice plots, indicative of tweed and ω-phase instabilities, respectively. The atomic displacements causing the ⟨110⟩ diffuse streaking could generally be classified as {110}⟨1-10⟩ local shears, in agreement with accepted models of tweed. However, the displacements producing the ⟨112⟩* streaking were best described as coordinated atom row motions in ⟨111⟩ directions, which does not agree with traditional ω-phase models based on (111) interplanar collapse. Both types of diffuse streaking decreased with increasing temperature, but the ⟨110⟩ type was stronger at all temperatures and persisted to higher temperatures. Furthermore, the atomic displacements producing the streaking were static at low temperatures (persistence times greater than 1000 vibrational periods) but became dynamic at higher temperatures (persistence times of the order of a few vibrational periods). Another interesting result was that by merely rearranging the extra Ni atoms into an ordered superlattice pattern, virtually no diffuse streaking of any type was observed at any temperature, strongly

suggesting that compositional disorder (or other kinds of point defects) are essential to induce tweed instabilities. The asterisk represents a quantity in reciprocal space. 9 refs., 6 figs.

13082 (UCRL-JC–106151) **The electronic structure of grain boundaries in Nb.** Sowa, E.C. (Lawrence Livermore National Lab., CA (USA)); Gonis, A.; Zhang, X.G. Lawrence Livermore National Lab., CA (USA). Nov 1990. 4p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901105–99: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008572. Source: OSTI; NTIS; INIS; GPO Dep.

We present first-principles calculations of the electronic structure of Nb grain boundaries. These are the first such calculations for a bcc metal using the real-space multiple-scattering theory (RSMST). Local densities of states near a Σ5 twist grain boundary are compared to those for bulk Nb. 5 refs., 1 fig.

13083 (UCRL-JC–106152) **HRM investigation of the structure of the Σ5(310)/[001] symmetric tilt grain boundary in Nb.** King, W.E. (Lawrence Livermore National Lab., CA (USA)); Coombs, A.; Campbell, G.H.; Mills, M.J.; Ruehle, M. Lawrence Livermore National Lab., CA (USA). Nov 1990. 9p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901105–101: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008571. Source: OSTI; NTIS; GPO Dep.

Recent atomistic simulations using interatomic potentials for Nb developed employing the embedded atom method (EAM) and the model generalized pseudopotential theory (MGPT) have indicated a possible cusp at the Σ5(310) orientation in the energy vs tilt angle curves for ⟨001⟩ symmetric tilt grain boundaries. In addition, the most stable structure predicted using EAM exhibits shifts of one crystal relative to the other along the tilt axis and along the direction perpendicular to the tilt axis lying in the boundary plane. The structure predicted using the MGPT was mirror symmetric across the plane of the grain boundary. This boundary has been prepared for experimental study using the ultra high vacuum diffusion bonding methods. A segment of this boundary has been studied using high resolution electron microscopy. 4 refs., 3 figs.

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Refer also to citation(s) 12318, 12536, 12636, 12756, 12925, 12945, 13057, 13077, 13114, 13121, 13170, 13254, 13830

13084 (ANL/CP–71423) **Defects, oxygen ordering and properties of La-Cu-O and Ba-Bi-O superconductors.** Dabrowski, B. (Science and Technology Center for Superconductivity (USA)); Pei, Shiyou; Richards, D.R.; Jorgensen, J.D.; Hinks, D.G.; Zheng, Y.; Mitchell, A.W. Argonne National Lab., IL (USA). [1990]. 25p. Sponsored by USDOE, Was. DOE Contract W-31109-ENG-38. Contract STC-8809854. (CONF-9002172–1: 26. winter school of theoretical physics, Karpacz (Poland), 19 Feb - 3 mar 1990). Order Number DE91008811. Source: OSTI; NTIS; GPO Dep.

The role of synthesis conditions and oxygen treatment used for obtaining reproducible samples and reliable measurements leading to an understanding of the nature of high temperature superconductivity are discussed for $La_2CuO_{4+\delta}$ and $Ba_{1-x}K_xBiO_3$. In both of these systems the oxygen defects are necessary to convert the semiconducting parent compounds into the doped conducting materials. For $La_2CuO_{4+\delta}$, the superconductivity is due to excess oxygen which leads to phase separation and complex structural and transport properties. Oxygen deficiency is necessary for potassium incorporation into $BaBiO_3$. The superconductivity in $Ba_{1-x}K_xBiO_3$ is well described by the BCS theory in the weak to moderate coupling limit. The high $T_c$is caused by a large $\langle\omega\rangle$ due to the strong interaction of electrons with high energy optical phonons. 22 refs., 15 figs.

13085 (ANL/CP–72495) **Phase equilibria in the Bi-Sr-Ca-Cu-O system near the $Bi_2Sr_2Ca_1Cu_2O_y$ superconductor at 865°C in oxygen.** Holesinger, T.G. (Argonne National Lab., IL (USA)); Miller, D.J.; Chumbley, L.S. Argonne National Lab., IL (USA). [1991]. 15p. Sponsored by USDOE, Washington. DOE Contract W-31109-ENG-38 ;W-7405-ENG-82. Contract STC-8809854. (CONF-910202–4: Annual meeting and exhibition of the Minerals, Metals and Materials Society, New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91008831. Source: OSTI; NTIS; GPO Dep.

Phase relations in the Bi-Sr-Ca-Cu-O system near the $Bi_2Sr_2Ca_1Cu_2O_y$ (2212) superconductor composition have been studied at 865°C in oxygen by systematically varying concentration of one element at a time. The resultant phases were identified by energy dispersive spectrometry (EDS) in a scanning electron microscope (SEM) and x-ray analysis while superconducting properties were evaluated based on resistance and magnetometer measurements. Slight variations in the stoichiometry of the 2212 phase with starting compositions have been observed. Transition temperatures (T_c) were correlated with overall sample composition as well as the composition of the superconducting phase. 17 refs., 4 figs., 6 tabs.

13086 (BNL–43779) **Magnetic field induced broadening of the resistive transition in epitaxial films of $YBa_2Cu_3O_7$ and $Y_2Ba_4Cu_8O_{16}$.** Budhani, R.C.; Suenaga, M.; Welch, D.O. Brookhaven National Lab., Upton, NY (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-900432–2: Science and technology of thin-film superconductors conference, Denver, CO (USA), 30 Apr - 4 may 1990). Order Number DE91009825. Source: OSTI; NTIS; GPO Dep.

In this paper we report measurements of the resistive transition in $YBa_2Cu_3O_7$ and $Y_2Ba_4Cu_8O_{16}$ films as a function of transport current density coplanar with applied magnetic field and the CuO_2 planes. For both transverse and longitudinal current-field configurations, we observe a significant broadening of the transition. For low excitation currents, the strength of the dissipation is identical for longitudinal and transverse fields. At high transport currents, where the Current-Voltage (I-V) curves are non-linear, the transverse field however, results in a Lorentz force instability in the flux line lattice and a higher dissipation. Various physical processes which might lead to unusually large broadening of the transition observed in all classes of cuprate superconductors are discussed. 32 refs., 8 figs.

13087 (CEA-CONF–10421) **Structural properties of high T_c -superconductors.** Heger, G. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR)); Braden, M.; Schweiss, P.; Hervieu, M.; Roth, G. Laboratoire Leon Brillouin (LLB) - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1990. 5p. (CONF-9003229–: French language colloquium on phase transitions, Djerba, TN (USA), 19-24 Mar 1990). Order Number DE91752729. Source: OSTI; NTIS (US Sales Only).

Different diffraction methods (single crystal and powder investigations by X-rays and neutrons, electron diffraction) are combined with high resolution electron microscopy in order to study the real structure of $YBa_2Cu_{3-\delta}O_{7-y}$. The phase transition at about y = 6.35 between the orthorhombic modification (y > 6.35) and the tetragonal structure of the $YBa_2Cu_3O_6$ type is related to a strongly reduced size of the microdomains. Mixed systems have been studied where Cu is partially substituted by Fe, Ni and Zn. Similar diffraction studies on the $(La_{1-x}Sr_x)_2CuO_{4-\delta}$ family show a more simple crystal structure of K_2NiF_4 type with only one Cu site, which seems to be always fully occupied.

13088 (CONF-901105–104) **The nucleation and growth of polycrystalline silicon carbide.** Sheldon, B.W.; Besmann, T.M. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. Depar. DOE Contract AC05-84OR21400. From Fall meeting of the Materials Research Society; Boston, MA (USA); 24 Nov - 1 dec 1990. Order Number DE91008887. Source: OSTI; NTIS; GPO Dep.

Silicon carbide was deposited from methyltrichlorosilane onto polished polycrystalline SiC substrates at reduced pressure, and the resultant surface morphology was characterized by analyzing the angular spectrum of scattered light which was generated with a He-Ne laser. Light-scattering analyses incorporating specific nucleation and growth models were developed. With these methods, it was possible to analyze the angular scattering spectra and directly measure the nucleation and growth rates. These results were verified by using image analysis to quantify the number and size distribution of surface features that were observed with scanning electron microscopy. The nucleation and growth rates that were obtained by fitting the models to the image-analysis results were in

good agreement with the rates obtained from the light-scattering. 7 refs., 2 figs.

13089 (CONF-901105–105) **Formation of mixed oxide powders in a counterflow diffusion flame burner.** Katz, J.L.; Hung, Cheng-Hung. Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemical Engineering. Aug 1990. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER45356. From Fall meeting of the Materials Research Society; Boston, MA (USA); 24 Nov - 1 dec 1990. Order Number DE91008980. Source: OSTI; NTIS; GPO Dep.

$SiCl_4$ and $TiCl_4$ were used as source materials for the formation of the SiO_2/TiO_2 mixed oxides in $H_2/Ar\text{-}O_2/Ar$ flames. A rectangular counterflow diffusion flame burner was used for this study. The key feature of this burner is that the gas flow along the stagnation streamline is essentially one dimensional. This enables one to accurately measure the temperature, species concentration, and particle size using optical methods. Also, it greatly reduces the number of measurements required in order to follow the particle formation process. In-situ particle sizes were determined using dynamic light scattering measurements. A thermopheric sampling method was also used to collect particles directly onto carbon coated grids, and their size and morphology were examined using a transmission electron microscope (Philips EM420ST). A photomultiplier at 90° to the argon ion laser beam was used to measure the light scattering intensity and the polarization ratio. 6 refs., 4 figs.

13090 (CONF-901194–13) **Scaling theory and simulations of fracture in disordered media.** Duxbury, P.M.; Kim, S.G. Michigan State Univ., East Lansing, MI (USA). [1990]. 12p. Sponsored by USDOE,. DOE Contract FG02-90ER45418. From American Society of Mechanical Engineers (ASME) winter annual meeting; Dallas, TX (USA); 25-30 Nov 1990. Order Number DE91008516. Source: OSTI; NTIS; GPO Dep.

Fracture in disordered media is a difficult problem due to a complex interplay between the intrinsic disorder and the evolution of damage. Extensions of network models used to study the elastic and transport properties of random media have been recently used to study fracture. We discuss two representative examples of these models. Randomly diluted networks show a dilute limit singularity and size effect in tensile strength. Bounds on fracture critical exponents are found using percolation theory scaling arguments. Dilute limit fracture statistics obey a modified Gumbel form. Results on networks with random rigid and strong bonds are more preliminary. This system shows a crossover from brittle fracture to a damage mechanism as a function of the volume fraction of stiff inclusions. 19 refs., 6 figs.

13091 (CONF-910162–6) **Effect of post-sintering microwave treatments upon the mechanical performance of silicon nitride.** Ferber, M.K.; Tiegs, T.N.; Jenkins, M.G. Oak Ridge National Lab., TN (USA). [1991]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 15. annual conference on composites and advanced ceramics; Cocoa Beach, FL (USA); 13-16 Jan 1991. Order Number DE91009122. Source: OSTI; NTIS; GPO Dep.

Post sintering heat treatments were used to vary the microstructural characteristics in two types of hot-pressed silicon nitride. Particular emphasis was placed upon comparing changes in grain size; degree of crystallization of the intergranular phases; and chemistry of the intergranular phases resulting from conventional and microwave annealing. The effect of these post-sintering treatments upon the mechanical performance was evaluated by measuring the creep deflection in flexure as a function of time and applied stress at 1260 and 1370°C in air. 16 refs., 8 figs., 2 tabs.

13092 (DOE/ER/45305–1) **High resolution energy loss research: Si compounds and ceramics: Progress report, June 1, 1990–January 1, 1991.** Carpenter, R.W.; Lin, S.H. Arizona State Univ., Tempe, AZ (USA). 6 Dec 1990. 3p. Sponsored by USDOE,. DOE Contract FG02-87ER45305. Order Number DE91009047. Source: OSTI; NTIS; GPO Dep.

This report briefly discusses work on silicon compounds using electron energy loss spectroscopy and high resolution techniques. Materials, theory, and instrumentation advances are detailed. (JL)

13093 (DOE/ER/45427–1-Pt.1) **Progress report for MISCON the Midwest Superconductivity Consortium: Part 1.** Schindler, A.I. Purdue Univ., Lafayette, IN (USA). Jan 1991. 11p. Sponsored by USDOE,. DOE Contract FG02-90ER45427. Order Number DE91008266. Source: OSTI; NTIS; GPO Dep.

The Midwest Superconductivity Consortium has been established to address the materials related issues limiting the commercialization of high $T_c$superconductivity technology and in response to Congressional direction to create a new midwest superconductivity consortium. High $T_c$superconductor materials are of interest to the Department of Energy because they have the potential to impact strongly the energy related needs of this country. The Consortium brings together a demonstrated group of university personnel with talents in the areas critical to the needs of understanding and developing these new superconductor materials. The charter membership of the Consortium includes Purdue University, University of Notre Dame, Indiana University, Iowa State University, University of Missouri and the Ohio State University, with the Consortium center being located at Purdue University. The management structure of MISCON consisting of both administrative and technical components has been established. The Director, and members of the Steering Committee and of the Program Committee have been selected. The Program Committee has selected two major research thrust areas for Consortium programs. Project proposals have been solicited and following an extensive review, fourteen projects were selected for funding. Work on these fourteen projects is now underway.

13094 (DOE/ER/45427–1-Pt.2) **Progress report for MISCON the Midwest Superconductivity Consortium: Part 2.** Schindler, A.I. Purdue Univ., Lafayette, IN (USA). Jan 1991. 38p. Sponsored by USDOE,. DOE Contract FG02-90ER45427. Order Number DE91008267. Source: OSTI; NTIS; GPO Dep.

The Midwest Superconductivity Consortium has been established to address the materials related issues limiting the commercialization of high $T_c$superconductivity technology and in response to Congressional direction to create a new midwest superconductivity consortium. High $T_c$superconductor materials are of interest to the Department Energy because they have the potential to impact strongly the energy related needs of this country. The Consortium brings together a demonstrated group of university personnel with talents in the areas critical to the needs of understanding and developing these new superconductor materials. The charter membership of the Consortium includes Purdue University, University of Notre Dame, Indiana University, Iowa State University, University of Missouri and The Ohio State University, with the Consortium center being located at Purdue University. The management structure of MISCON consisting of both administrative and technical components has been established. The Director, and members of the Steering Committee and of the Program Committee have been selected. The Program Committee has selected two major research thrust areas for Consortium programs. Project proposals have been solicited and following an extensive review, fourteen projects were selected for funding. Work on these fourteen projects is now underway.

13095 (ENEA-RT-TIB–89-78) **Resonance C.A.R.S. detection of SiC_2 as reaction intermediate in I.R. laser synthesis of SiC from SiH_4-hydrocarbon mixtures.** Fantoni, R.; Bijnen, F.; Djuric, N.; Piccirillo, S. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. Sep 1990. 21p. (RT/TIB–89-78). Order Number DE91752917. Source: OSTI; NTIS (US Sales Only); INIS.

Coherent Antistokes Raman Scattering (CARS) was employed to investigate the gas-phase reactions between SiH_4 and small hydrocarbons leading to the formation of SiC powders. SiC_2 was identified as a reaction intermediate, due to the occurrence of resonance enhanced CARS coupling vibrational levels in the ground and first electronically excited states. The rich structure observed in the range 4480 A < $lambda_{AS}$ < 4650 A was assigned to SiC_2 taking into account the cyclic geometry of this species and revising former data on A-tilde-X-tilde electronic transitions.

13096 (ETDE-mf–1756465) **Improving the material properties of ceramic powders by means of ion irradiation. Final report.** Frey, H.; Jehn, H.; Telle, R.; Schils, H.W.; Heuberger, M.; Seger, R.; Eisenloher, J.; Strecker, K. Loet- und Schweissgeraete

GmbH, Aichwald (Germany, F.R.); Forschungsinstitut fuer Edelmetalle und Metallchemie, Schwaebisch Gmuend (Germany, F.R.); Max-Planck-Institut fuer Metallforschung, Stuttgart (Germany, F.R.). Inst. fuer Werkstoffwissenschaften; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 31 Jul 1990 22p. (In German). Contract BMFT 03 M 2026. Order Number DE91756465. Source: OSTI; NTIS (US Sales Only).

The objective of this research project was to translate the application of ion implantation, which has previously been restricted to the surface of materials, to ceramic powders. In the process surface conditions of powder particles were to be influenced by (1) removal of oxide layers, (2) amorphisation, and/or (3) integration of foreign atoms to give an improved sintering behaviour or improved physico-chemical properties of components made of these powders. The following combinations of materials (basic material and dope additive) were tested: Al_2O_3 + ZrO_2, Al_2O_3 + Pt, Al_2O_3 + Ni, ZrO_2 + Y_2O_3, B_4C + Si/SiC, B_4C + Ar/Xe, SiC + C, SiC + Ar/Xe, TiC + Si/SiC. (orig./MM) With 27 refs.

13097 (FhG-IWM-W–10/90) **Optimization of selected ceramic high temperature materials with regard to strength, fatigue and state of the surfaces. Final report.** Pfeiffer, W.; Berweiler, W.; Hollstein, T. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1990. 185p. (In German). Contract BMFT 03M2011C2. Order Number DE91759376. Source: OSTI; NTIS (US Sales Only).

This partial project of the research project 'machining, joining and testing of components from high performance ceramic material' examine the relationship between intrinsic stresses from processing (lapping, grinding, eroding, ultrasonic lapping) of the surfaces and the strength of ceramic plates. The following materials were used for this project: Alumina, partly stabilized zirconium dioxide, silicon carbide and silicon nitride. The surface state was judged through strength measurements in the double interlaboratory experiment, through scanning electron microscope fractography and ceramography and through radiographic intrinsic stress measurements and deformation measurements. For some ceramic materials, (long-term) fatigue behaviour and crack propagation behavior was also examined for the strength and intrinsic stress behavior in addition to influence of processing with temperatures to 1500deg C. In addition to the derivation of failure probability diagrams (life forecast), a new model was derived on the basis of these results, with whose aid the crack toughness increasing with the crack extension (R-curve effect) can be described for two different test piece geometries. (orig./MM).

13098 (KFK–4791) **Stress intensity factors and weight functions for the edge cracked plate calculated by the boundary collocation method.** Fett, T. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung. Sep 1990. 61p. Order Number DE91754838. Source: OSTI; NTIS (US Sales Only); INIS.

The determination of stress intensity factors for cracks exposed to arbitrary stress distribution according to the weight function method calls for knowledge of the crack opening displacements and stress intensity factor for a reference load case. The determination of these variables by means of the Boundary Collocation Method (BCM) is discussed by the example of the drawn plate with an edge crack. After derivation of the formulas for evaluation the influence is studied of the relative crack depth and the plate length on the stress intensity factor, and the results are compared with data from the literature. The crack opening displacement field is determined from the stress function established by the Boundary Collocation Method and the fracture mechanical weight function is calculated from it. The results are compared with an analytical weight function obtained on the basis of approximative crack opening displacement fields. A formula is indicated for the weight function which covers the total range from a/W=0 to a/W=1. This formula is the result of BCM computations made up to a/W=0.8 for a relative plate length of a/H > 1.5 and applies to the limit case a/W=1 known from the analysis. Finally the Boundary Collocation Method is used to calculate the mode II stress intensity factors for shear loaded plates with an edge crack. The results of the computations are compared with solutions proposed in the literature. For the edge crack loaded with constant shear stresses, which act on the crack surfaces, a numerical formula is given of the geometric function. Values applicable to the weight function are determined from the crack opening displacements. (orig.).

13099 (LBL–29843) **Structural characterization of the Ag/$YBa_2Cu_3O_{7-x}$ interface.** Tidjani, M.E. Lawrence Berkeley Lab., CA (USA). May 1990. 115p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. Order Number DE91009112. Source: OSTI; NTIS; GPO Dep.

Most applications of superconductors (i.e. power transmission cables and tapes, electronic circuits, supermagnets) require some interface with a power source or an electronic device that enables electrons to be injected into, and removed from the superconductor. The quality of metal-ceramic contacts in strongly dependent upon the structural properties of the metal-ceramic interface which depends on the processing conditions and the interaction between the two materials in contact. The present research is intended to characterize the interface microstructure and long term stability of the deposited silver metal in contact to the superconducting oxide $YBa_2Cu_3O_{7-x}$ (YBCO). 117 refs., 35 figs.

13100 (ORNL/TM–11735) **High Temperature Materials Laboratory third annual report: October 1989–September 1990.** Tennery, V.J.; Foust, F.M. Oak Ridge National Lab., TN (USA). Dec 1990. 67p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91007821. Source: OSTI; NTIS; GPO Dep.

The High Temperature Materials Laboratory has completed its third year of operation as a designated DOE User Facility at the Oak Ridge National Laboratory. Growth of the user program is evidenced by the number of outside institutions who have executed user agreements since the facility began operation in 1987. A total of 88 nonproprietary agreements (40 university and 48 industry) and 20 proprietary agreements (1 university, 19 industry) are now in effect. Sixty-eight nonproprietary research proposals (39 from university, 28 from industry, and 1 other government facility) and 8 proprietary proposals were considered during this reporting period. Research projects active in FY 1990 are summarized.

13101 (PNL-SA–18588) **Defect enhancement of local electric fields in dielectric films.** Risser, S.M.: Ferris, K.F. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 8p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-9010146–3: 22. annual symposium on optical materials for high power lasers, Boulder, CO (USA), 24-26 Oct 1990). Order Number DE91008829. Source: OSTI; NTIS; GPO Dep.

Different film deposition techniques have been found to generate distinct grain morphologies and defect distributions, which can result in a wide distribution of local field intensities. We have developed a lattice element model of an inhomogeneous medium, which we use to self-consistently determine the local internal electric field and polarization. We use this method to show the sensitivity of the polarization to defect shape. The results of this method predict the local field to have a large range of values within the film and have been used to identify regions where the local field is a maximum.

13102 (PNL-SA–18908) **Engineering property limitations of structural ceramics and ceramic composites above 1600°C.** Courtright, E.L. Pacific Northwest Lab., Richland, WA (USA). Jan 1991. 34p. Sponsored by USDOE. Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-910162–4: 15. annual conference on composites and advanced ceramics, Cocoa Beach, FL (USA). 13-16 Jan 1991). Order Number DE91009105. Source: OSTI; NTIS; GPO Dep.

Current high temperature performance limitations for structural ceramics associated with design related requirements, e.g. creep, fracture toughness, fatigue, and oxidation resistance are reviewed. Non-oxide ceramics exhibit good strength at low temperatures, but do not retain their strength at high temperatures and generally do not have adequate oxidative stability. While many oxides are thermochemically stable at high temperatures in oxidizing atmospheres, the rate of oxygen permeation is very high and this leads to interface degradation when non-oxide fibers are used as reinforcements. Most oxides also exhibit poor high temperature strength and creep resistance, but recent research suggests that

acceptable levels of creep resistance may be achievable in single crystals. While toughness in a ceramic matrix composite is generally thought to be a function of interface sliding between fiber and matrix coupled with other crack deflection processes, adequate matrix toughness is also required. Cyclic fatigue resistance is another performance limiting concern in ceramic matrix composites. 46 refs., 7 figs., 3 tabs.

13103 (SAND–89-2869C) **On the crystal structure of boron carbides.** Morosin, B.; Aselage, T.L.; Emin, D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 4p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-900870–10: 10. international symposium on borons, borides and related compounds, Albuquerque, NM (USA), 27-30 Aug 1990). Order Number DE91009256. Source: OSTI; NTIS; GPO Dep.

Several crystals of boron carbide, grown from molten Cu, Pt and Pd solutions using natural occurring as well as isotopically enriched boron, give essentially identical values for the lattice parameters. These parameters are consistent with carbon-saturated compositions near B_4C. Detailed crystal structure refinement on some of these crystals yields positional and thermal parameters in good agreement with each other. More important, the thermal parameters of these studies are compared with those of crystals with lower carbon content (e.g., $B_{13}C_2$) as well as carbothermal prepared crystals. The thermal parameters of chain atoms for crystals with lower carbon content are both exceptionally large and much larger than those of crystals with composition near B_4C. This result suggests that the crystals of lower carbon content contain a solid solution of C-B-C and C-B-B chains. 11 refs., 1 tab.

13104 (SAND–90-2308C) **Low temperature dielectric properties and ac conductivities of the icosahedral boron carbides.** Samara, G.A.; Tardy, H.L.; Venturini, E.L.; Aselage, T.L.; Emin, D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-900870–9: 10. international symposium on boron, borides and related compounds. Albuquerque, NM (USA), 27-30 Aug 1990). Order Number DE91008577. Source: OSTI; NTIS; GPO Dep.

The temperature and frequency dependences of the dielectric functions and ac conductivities (σ_{ac}) of several boron carbide compositions in the single phase region (9–20 at. % C) have been investigated. The low temperature (<25 K) responses are found to be characteristic of phonon-assisted hopping transport. Evaluation of the various contributions to the real part of the dielectric constant shows that the electronic contribution is relatively large ($\varepsilon'_{infinity} \simeq 6$) whereas the lattice contribution is small ($\varepsilon'_1 \approx 0.2$-2.0), a situation akin to that of the highly covalent semiconductors. This result implies that the electron-lattice interaction in these materials is of short range. The dipolar contribution, ε'_d, which arises from the hopping motion of localized carriers, dominates the response at low frequencies. σ_{ac} exhibits a power law dependence on frequency, $\sigma(\omega) = A\omega^s$, where s = 0.85-0.90 at 4 K and decreases with increasing temperature. The results are discussed in terms of various hopping models. 15 refs., 4 figs.

13105 (SAND–91-0169) **FWP executive summaries: Basic energy sciences, materials sciences programs.** Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 49p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009223. Source: OSTI; NTIS: GPO Dep.

Research programs from Sandia Laboratory in Materials Science are briefly presented. Significant accomplishments include: preparation of Tl superconductors under equilibrium conditions, development of force-feedback sensor for interfacial force microscope, predictive model of hydrogen interactions in silicon dioxide on silicon, layer-by-layer sputtering of Si (001), oscillatory As_4 surface reaction rates during molecular beam epitaxy of AlAs, GaAs and InAs, the effects of interfacial strain on the band offsets of lattice matched III-V semiconductor, a new mechanism for surface diffusion, solid solution effects in Tl-containing superconductors, record high superconducting transitions for organic materials, atomic vibrations in boron carbides and a method for studying radical/surface reactions in chemical vapor deposition (CVD).

13106 Process for producing a high-temperature superconductor. Baumann, T.; Unternahrer, P. 24 Oct 1990. Filed date 23 Apr 1990. Canada Patent patent application 2015168. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to the production of superconductors having critical temperatures up to 125°K based on the formula $A_{n1}B_{n2-e1}Ca_{n3+e1}Cu_{n4}O_{n5+e2}$. In this formula, A is Tl, Bi, or Pb, or a mixture of these metals; B is Be, Mg, Sr, Ba, Ra, or a mixture of these elements; n1 is 1 or 2; n2 is 1, 2, or 3; n3 is 2; n4 is 2, 3, or 4; n5 is 8, 9, 10, or 11; $|e1| \leq 1$; and $|e2|1$. Conventionally produced sintered ceramics of such superconductors have a critical current density of up to ca 250 A/cm^2 which is too low for applications such as high-power magnetic coils. In order to achieve a critical current density of >1750 A/cm^2 in such superconductors, the superconductor synthesis is carried out in a main process at a temperature in the region of 650-900°C for a time in the region of 1-100 h. Prior to this, a presynthesis heat treatment can be carried out at a temperature in the 650-900°C range for 0.5-10 h for the purpose of degassing, and a grain melting can be performed at >900°C for 1 min-1 h for the purpose of material compaction. To establish the desired oxygen stoichiometry, a post-treatment at 300-750°C for 0.5-5 h in an oxygen atmosphere of ≤0.1 bar partial pressure can be provided after the main process. Experiments are described to illustrate the processes of the invention.

3606 Other Materials

Refer also to citation(s) 12320, 12423, 12469, 12517, 12518, 12519, 12548, 12819, 13090, 13146, 13147, 13177, 13179, 13331, 13353, 13383, 13757

13107 (CEA-CONF–10277) **Induction plasma torch. Recent developments, application to fusion of glass and refractory materials.** Hery, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. de Genie Radioactif); Boen, R.; Delage, D. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1988. 12p. (In French). (CONF-8810322–: 11. international conference on electroheat, Malaga (Spain), 3-7 Oct 1988). Order Number DE91752710. Source: OSTI; NTIS (US Sales Only).

Concurrently with the arc plasma techniques, we have been witnessing renewed interest over the last few years for the thermal induction plasma techniques in such differing fields as the chemical industry, fine metallurgy and heating. In the field of induction plasma torches, quartz-tube torches -which are fragile at high power- are being replaced by torches made up of water-cooled copper coil turns. Applications of the induction plasma technology include quartz synthesis for optical fibre, silicon purification for photo-voltaic applications and metal refining. As a result of CEA-CFEI joint works, the induction plasma torch is also used for glass heating prior to direct induction melting.

13108 (CEA-CONF–10408) **R.S.S.T. in granite: additional tests at Cen-Valrho.** Dussossoy, J.L. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Vernaz, E.; Charpentier, H.; Juliet, P. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1988. 6p. (CONF-8810189–: Commission of European Communities workshop on testing of high level waste forms under repository conditions, Cadarache (France), 17-21 Oct 1988). Order Number DE91752708. Source: OSTI; NTIS (US Sales Only).

The Rhone Valley Nuclear Research Center (CEN Valrho) is participating in the Round Robin Test for repository systems simulation with granite. In addition to the compulsory portion of the test (i.e. Si, B, Mo and Li analysis and pH measurement) a number of additional tests were also carried out. These included the following: analysis for Zr, U, Ce and Nd to simulate actinide behavior; scanning transmission electron microscope (STEM) examination of samples leached for 28 and 91 days; secondary ion mass spectrometry (SIMS) examination of a sample leached for 91 days. An investigation of differences in glass corrosion according to the procedure used to prepare the material column is also discussed.

13109 (CEA-CONF–10409) **Examination of ultrathin cross sections from R7T7 glass samples after 6 months and 1 year**

of alteration in the Wipp. Vernaz, E.; Godon, N. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1988. 10p. (CONF-8810189–: Commission of European Communities workshop on testing of high level waste forms under repository conditions, Cadarache (France), 17-21 Oct 1988). Order Number DE91752709. Source: OSTI; NTIS (US Sales Only).

Three stacked R7T7 glass slices were subjected to alteration tests for six months and one year at 90°C as part of the WIPP experiments in New Mexico, in contact either with salt from the Salado salt dome or with brine at equilibrium with the natural salt formation. Ultrathin cross sections were taken from the samples to reveal the degree of glass alteration at the glass/brine, glass/salt and glass/glass interfaces. The alteration films were from 4 to 15 μm thick and the thickest films were found at the glass/brine interface. Magnesium in the salt has a major role in the development of the alteration films, and was the principal element in most of the surface layers. No rare earths were observed in the alteration films, suggesting that little or no actinide retention by the surface layer occurs in this environment. 6 refs.

13110 (CONF-910162–5) **Gelcast reaction-bonded silicon nitride composites.** Omatete, O.O.; Tiegs, T.N.; Young, A.C. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 15. annual conference on composites and advanced ceramics; Cocoa Beach, FL (USA); 13-16 Jan 1991. Order Number DE91009134. Source: OSTI; NTIS; GPO Dep.

Nicalon fiber-reinforced, reaction-bonded silicon nitride (RBSN) composites were made by gelcasting green bodies of Si and fibers and nitriding the composites in a 2.45-GHz microwave furnace. The bodies were prepared by casting a 48 vol % slurry of silicon into a mold containing unidirectional fibers cut to the length of the mold. The extent of nitridation and the properties of the reaction-bonded silicon nitride composites were measured. Fracture surfaces of the composites processed at 1250°C for 8 h showed significant fiber pullout; however, those nitrided at 1350°C for 4 h exhibited only limited fiber pullout indicating possibly some degree of fiber degradation and strong matrix-fiber bonding. 17 refs., 3 figs., 1 tab.

13111 (CONF-8909163–Vol.2, pp. 223-273) **Physical properties in LLNL Yucca Flat areas: The Rock Pile concept.** Burkhard, N.R. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Analysis of the measurements indicates that an adequate sampling of the units in Yucca Flat has been obtained for the average physical properties of the stratigraphic units. The author proposes that the following methodology be considered as an adequate characterization of the physical properties of a LLNL Yucca Flat site. The grain densities, bulk densities, water contents, porosities, gas-filled porosities, and saturations of the stratigraphic units would be assumed from the overall zonal averages for each stratigraphic unit. The average overburden velocity and the average workpoint velocity would be taken from the curves fit to these properties as a function of depth. The average overburden density would be calculated from the stratigraphic thicknesses of the units and the densities associated with each unit. No other logs, samples, or measurements would be required to characterize the physical properties of a LLNL Yucca Flat site. The carbonate content of the alluvial portion of an interval about a proposed working point (based on 3300 metric tonnes/kiloton of yield) would be measured. The stratigraphy would be determined from cuttings, downhole photography, a magnetic log, and a gamma log. A bulk density log would serve as the anomalous property indicator and would be used in two different ways. First, stratigraphic zonal averages from the bulk density log would be checked against the assumed data. If the zonal log average values fell outside two standard deviations of the assumed zonal average, the unit would be considered anomalous and a more complete analysis of the site would be required. Second, the bulk density log would be examined to determine whether any unusual variations in density which were outside of experience existed within a stratigraphic unit. The paper contains seven appendices of physical property data on Yucca Flat locations.

13112 (DOE/ER/13389–3) **Thin-film composite membranes for artificial photosynthesis: Final report, July 15, 1985–March 31, 1989.** Wamser, C.C. (Portland State Univ., OR (USA). Dept. of Chemistry); Lonsdale, H.K. Portland State Univ., OR (USA). Dept. of Chemistry; Bend Research, Inc., OR (USA). [1989]. 37p. Sponsored by USDOE,. DOE Contract FG06-85ER13389. Order Number DE91008276. Source: OSTI; NTIS; GPO Dep.

This research program has investigated the preparation and properties of a novel type of thin, asymmetric polymer film, made from pairs of reactive porphyrin derivatives by interfacial polymerization. One monomer was typically tetraphenylporphyrin derivatized with acid chloride functional groups (TCCPP), which was allowed to react with either an amine- or hydroxyl-derivatized tetraphenylporphyrin (TAPP or THPP) or an aliphatic polyamine. The structural asymmetry of the polyporphyrin films has been demonstrated by reflectance infrared spectroscopy, contact angle measurements as a function of pH, and by X-ray photoelectron spectroscopy (XPS) of surface elemental compositions. The major effort during the first year of this program focused on the preparation and characterization of the polyporphyrin films. A variety of modifications of the standard procedures for interfacial polymerization were necessary to accommodate the special properties of the porphyrin monomers and the highly crosslinked polyporphyrin films. During the second year, the major thrust was to develop methods for handling the films as membranes, i.e. in contact with aqueous solutions, as well as the collection of evidence for structural asymmetry of the films. Satisfactory methods for using the films as membranes in standard liquid cells were never found. The films are highly fragile, presumably because of the high degree of crosslinking, and they are highly permeable to aqueous solutes. Nevertheless, dry films could be mounted onto electrodes and irradiated, demonstrating asymmetric photoeffects that clearly indicated their potential as solid-state thin-film photoconductors. the study of these effects comprised the majority of the work during the final year of this program. In addition, the application of contact angle studies and XPS studies provides definitive evidence for surface asymmetry of the polyporphyrin films.

13113 (DOE/ER/45194–6) **The organic chemistry of conducting polymers: Progress report, April 1, 1990–January 31, 1991.** Tolbert, L.M. Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemistry and Biochemistry. 17 Feb 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-85ER45194. Order Number DE91009520. Source: OSTI; NTIS; GPO Dep.

This report contains sections on (1) structure of the soliton. Resonance-stabilized carbanions are used as soliton model compounds. (2) Interchain charge transport. Mechanisms for interchain charge transfer are divided into two classes, those involving electron transfer between neutral and charged solitons and those involving bipolarons. (3) Proton-transfer doping. "N-doping" was achieved using a strong base and a carbon acid precursor polymer. (4) Charge-transfer heteropolymers. Copolymerizations involving pyrrole and benzoquinone; thiophene and benzeoquinone; pyrrole and dimetheory benzene; and thiophene and dimethoxybenzaldehyde. 29 refs. (CBS)

13114 (DOE/ER/45252–T5) **Fracture behavior of surface-modified ceramics: Progress report, June 1, 1990–May 31, 1991.** Green, D.J. Pennsylvania State Univ., University Park, PA (USA). Dept. of Materials Science and Engineering. Jan 1991. 6p. Sponsored by USDOE,. DOE Contract FG02-86ER45252. Order Number DE91008841. Source: OSTI; NTIS; GPO Dep.

The overall objective of this work is to understand crack growth on surfaces that are being acted on by macroscopic residual stresses. In the current year work has been performed in 3 areas: (1) fracture behavior of ion-exchanged glasses; (2) fracture of SiC-coated graphite; and (3) sub-critical crack growth in ion-exchanged glasses. The work in the first two of these areas will be complete by the end of the current funding year and the third project was initiated in September 1990.

13115 (DOE/ER/45258–91-01) **The effects of point defects and disorder on structural phase transitions: Progress report, June 15, 1990–June 14, 1991.** Toulouse, J. Lehigh Univ., Bethlehem, PA (USA). Dept. of Physics. Jan 1991. 4p. Sponsored by USDOE.. DOE Contract FG02-86ER45258. Order Number DE91007973. Source: OSTI; NTIS; GPO Dep.

This report presents results from last year's work and proposed work for the effects of point defects and disorder on structural phase transitions in $KMnF_3$, $KZnF_3$ and KTN. (FI)

13116 (DOE/ER/45409–1) **Photomodulation spectroscopy of photocarrier dynamics, electronic defects and morphology of conducting polymers: Progress report.** Vardeny, Z.V. Utah Univ., Salt Lake City, UT (USA). Dept. of Physics. 16 Jan 1991. 9p. Sponsored by USDOE.. DOE Contract FG02-89ER45409. Order Number DE91007977. Source: OSTI; NTIS; GPO Dep.

This is a progress report on the first 18 months of activities associated with the DOE grant to the Physics Department of the University of Utah, starting October 1989, on photocarrier dynamics, electronic defects and morphology of conducting polymers using the photomodulation spectroscopy. During the first period of this grant we have already achieved impressive results and have started new studies, to be completed during the grant continuation period of the second year. We will describe our progress according to the material studied, since this is the best method to summarize our accomplishments. We have used a variety of techniques in our studies such as: CW photomodulation, photomodulation in the femtosecond and picosecond time ranges, CW resonant Raman scattering, transient photoinduced Raman scattering, electroabsorption and degenerate four-wave mixing. These techniques have been used to obtain the transient electronic response of the studied conducting polymers.

13117 (DP-MS–87-2-Rev.1) **Nuclear waste glass durability: 1, Predicting environmental response from thermodynamic (Pourbaix) diagrams: Revision 1.** Jantzen, C.M. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. [1987]. 52p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. (CONF-870422–14-Rev.1: 89. annual meeting of the American Ceramic Society, Pittsburgh, PA (USA), 26-30 Apr 1987). Order Number DE91009320. Source: OSTI; NTIS; GPO Dep.

To predict the long-term effects of groundwater contact on the durability of nuclear waste glass in a geologic repository the nature of the glass dissolution process must be understood. Hydration thermodynamics has been used to quantify the role of glass composition and the effect of solution pH. The glass compositons varied widely and included natural, lunar, medieval, and nuclear waste glasses, as well as, some glass-ceramics. The known effects of solution pH and oxidation potential (Eh) on glass dissolution are empirically described by thermodynamically calculated Pourbaix diagrams. Statistical analysis of over 300 glass durability tests demonstrated that the Pourbaix diagram could be quantified because of (1) the colinearity of the hydration free energy with solution pH defined by the Nernst equation, and (2) the colinearity of the solution pH with the concentration of dissolved silicon and boron in the solution defined by the pH dependence of the ion activities. 55 refs., 10 figs., 1 tab.

13118 (ENEA-RT-ENERG–90-02) **Characterization of structural and electronic properties in undoped hydrogenated amorphous silicon.** Stutzmann, M.; Nobile, G.; Rubino, A.; Menna, P. ENEA, Portici (Italy). Centro Ricerche Fotovoltaiche. Oct 1990. 18p. (RT/ENERG–90-02). Order Number DE91752918. Source: OSTI; NTIS (US Sales Only); INIS.

The correlation between the electronic and structural properties (e.g., density, microscopic origin, optical and electronic cross-sections, stability, etc.) of amorphous silicon predicted by a described model was verified for a series of a Si:H samples (deposited at different temperatures) by using Raman scattering and photothermal deflection spectroscopy (PDS) to measure the thin film optical absorption via laser probe deflection due to changes of the refractive index in a suitable deflection medium. It was found that by increasing the temperature, the TO-like position in the Raman spectra shifted towards higher energies whereas the corresponding peak width evidenced a minimum at around 300 degrees C. Eventually, the Urbach tail slope determined by PDS exhibited a similar behaviour.

13119 (ENEA-RT-TIB–89-68) **ArF excimer laser photolysis of tetramethyltin $Sn(CH_3)_4$ probed by dye laser mass spectroscopy.** Larciprete, R.; Fontana, S.; Borsella, E. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. Sep 1990. 18p. (RT/TIB–89-68). Order Number DE91752935. Source: OSTI; NTIS (US Sales Only); INIS.

ArF excimer laser photolysis of $Sn(CH_3)_4$, excited in resonance with its first dissociative absorption band, was studied by multiphoton ionization time-of-flight mass spectroscopy. Occurrence of methyl elimination after one UV photon absorption was identified by detecting the CH_3 radicals by dye laser induced resonant ionization at 333.5 nm. Results obtained performing two-color ionization experiments with 193 nm and blue laser photons give evidence for the presence of very efficient UV induced dissociation demonstrating the suitability of $Sn(CH_3)_4$ as a tin precursor for laser induced film deposition.

13120 (ENEA-RT-TIB–89-70) **Radiative and nonradiative processes in color centers.** Baldacchini, G. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. 1989. 42p. (RT/TIB–89-70). Order Number DE91752922. Source: OSTI; NTIS (US Sales Only); INIS.

The optical properties of color centers in alkali halides have been used in the past and are still used today in some noteworthy applications, e.g., dosimetry, information storage, and tunable near infrared lasers. However, a satisfactory description of the emission properties after excitation is still lacking. Thus, in order to reach a better understanding of the luminescent phenomena, the proper experimental results in F centers are reviewed and compared with the prevailing theory of the crossover model. This comparison shows that a complete agreement between theory and experiments is far from being reached.

13121 (ENEA-RT-TIB–89-75) **Investigation of laser induced silane/hydrocarbon reactions in formation of Si and SiC powders.** Fantoni, R.; Bijnen, F.; Piccirillo, S.; Enzo, S. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base; Venice Univ. (Italy). Sep 1990. 27p. (RT/TIB–89-75). Order Number DE91752924. Source: OSTI; NTIS (US Sales Only); INIS.

IR photodissociation of silane in the presence of different hydrocarbons (methane, C_2H_2, C_2H_4, C_2H_6) was performed in a flow reactor where a low power (up to 50 W.) c.w. carbon dioxide laser tuned at 944-19 cm^{minus1} was focussed. The broadband CARS (Coherent Antistokes Raman Scattering) technique was employed to monitor on-line the gas-phase reactions. Space-resolved detection of reactants dissociation and primary products formation was performed on the reaction flame. Evidence of C_2 formed in ground and electronically excited states was found. X-ray diffraction analysis was used to characterize the solid products, which resulted to be ultrafine Si and SiC powders with different crystalline phases according to the average reaction temperature.

13122 (Juel–2374) **Investigations for improved strength and oxidation resistance of coat-mix mould materials.** Prasse, H.; Luhleich, H.; Nickel, H. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.). Aug 1990. 132p. (In German). Order Number DE91754836. Source: OSTI; NTIS (US Sales Only).

Dissertation submitted by H. Prasse.

In a study to increase the oxidation resistance of coat-mix (CM)-material, several experiments for SiC-coatings were performed using different initial materials. Information from Japan states that successful SiC-coatings on porous materials were obtained by infiltration of a SiC-dispersion. Experiments to infiltrate CM-materials using this method were not successful. An infiltration depth of only several micrometers was reached and the pores were partly closed. In an other case, CM-material was infiltrated by heating the sample in a mixture of SiC and Si powder in which no melt was formed. The silicon was vaporized into the sample and reacted with the carbon of the material. With a high fraction of silicon in the mixture, only the outer surface of the sample was siliconized. In that case, the structure of the material was destroyed and the edges broke. In a mixture with less Si, a higher infiltration depth

was reached and the oxidation resistance was increased by 33%. As a third infiltration method, the CM-material was infiltrated by different Tetraethoxisilan solutions, which formed a SiO_2-framework through gelation and drying. The SiO_2 coated CM-samples were heated up thereafter. The SiO_2 reacted to form SiC with the carbon of the material. Complete infiltration and conversion to SiC, an absence of porosity in the layer, good adherence between layer and binder coke and increasing of the oxidation resistance have been achieved. However, the edge resistance and the accuracy of shape of the CM-mold material were decreased by the coating. (orig./MM).

13123 (LBL–29888) **Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell.** Yu, P.Y. (California Univ., Berkeley, CA (USA). Dept. of Physics); Li, M.F. Lawrence Berkeley Lab., CA (USA). Aug 1990. 10p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9008196–1: 4. international conference on high pressure in semiconductor physics, Porto Carras (Greece), 11-13 Aug 1990). Order Number DE91008927. Source: OSTI; NTIS; GPO Dep.

The use of diamond anvil high-pressure cells to study deep centers in semiconductors by means of capacitance transient spectroscopies is described. The technique is illustrated by recent results on DX centers induced by pressure in GaAs, the P_b center at the SiO_2/Si interface and the Schottky barrier formed by Pt on GaAs. 35 refs., 4 figs.

13124 (NIPER–488) **Effects of degree of hydrolysis and shear on gelation reaction kinetics and gel strength.** Gao, Hong W. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Feb 1991. 20p. Sponsored by USDOE,. DOE Contract FC22-83FE60149. Order Number DE91002225. Source: OSTI; NTIS; GPO Dep.

Gelation tests were conducted to investigate the effect of the degree of hydrolysis on gelation reaction kinetics and gel strength using four low-molecular-weight polyacrylamides (MW = 400,000 daltons), which were 10% (HPAM1-10), 20% (HPAM1-20), 30% (HAPM1-30), and 40% (HPAM-40) hydrolyzed, and Cr-3 (pH = 4.8) and Al-3 (pH = 7.0) crosslinkers. Results showed that for polymer/Cr-3 gel systems, samples prepared with a low-molecular-weight polyacrylamide polymer, which was 20% hydrolyzed, gelled at a faster rate and retained higher gel strength than those prepared with a low-molecular-weight polyacrylamide polymer, which was 10% hydrolyzed. Under the screening condition, no viscosity enhancement was observed in samples prepared with polymers having a degree of hydrolysis equal to or greater than 30%. For polymer/Al-3 gel systems, samples prepared with a low-molecular-weight polyacrylamide polymer, which was 20% hydrolyzed, gelled at the fastest rate and retained the strongest gel strength among the polymer/Al-3 gel systems prepared with four low-molecular-weight polyacrylamide polymers, which were 10, 20, 30, and 40% hydrolyzed, respectively. Gelation tests of gel systems in glass bead packs showed that high shear favored the gelation of a gel system that had a fast rate of gelation, but had an adverse effect on the gelation of three gel systems that had a slow rate of gelation. Weak gels were found to be injectable through porous media. Weak gels were degradable under high shear condition and regained viscosity under low shear conditions. 17 refs., 8 figs., 1 tab.

13125 (PNL-SA–18545) **Acoustic emission-fracture strength relations for Al/Gr composites.** Easterday, J.D. (Washington State Univ., Pullman, WA (USA)); Henager, C.H. Jr.; Friesel, M.A.; Jones, R.H.; Smith, M.T. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 14p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910202–7: Annual meeting and exhibition of the Minerals, Metals and Materials Society, New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91009106. Source: OSTI; NTIS; GPO Dep.

It has been demonstrated that strength degradation in Al/Gr fiber-reinforced composites can be detected by acoustic emission (AE) while being strained within the elastic range. This nondestructive method of distinguishing between "good" and "poor" metal-matrix composites may prove useful as a quality control tool. Specimens of 6061 Al/P100 graphite fiber-reinforced composite in the as-received and heat-treated conditions were monitored for AE response while being strained to 0.08%. Heat treatments were chosen to produce different quantities of aluminium carbide Al_4C_3 at the fiber/matrix interface. The increase in aluminum carbide reaction product caused a corresponding decrease in DEN failure strength. Examination of the number of AE events versus amplitude and stress, microstructures and fracture modes all provided insight to possible AE sources. Identification of these sources has the potential to provide information on degradation and/or failure mechanism of metal-matrix composites. 14 refs., 16 figs.

13126 (PNL-SA–18586) **Nonlinear optical properties of polyphosphazenes.** Risser, S.M.; Ferris, K.F. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 8p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-901105–106: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91009040. Source: OSTI; NTIS; GPO Dep.

Theoretical second hyperpolarizabilities for a series of iso-electronic conjugated inorganic systems, including polyphosphazenes, have been evaluated using electronic structure methods. The nonlinear optical properties of these molecules are controlled by the electronegativity difference along the backbone, which may be modulated by the electron donating/accepting properties of the ligands. 9 refs., 4 figs.

13127 (PNL-SA–18587) **Contributions of conformational and structural defects to the hyper-polarizabilities of polymers.** Risser, S.M.; Ferris, K.F. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-901105–107: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91009042. Source: OSTI; NTIS; GPO Dep.

The extent of the delocalized π electron network is of prime importance in determining hyperpolarizabilities of conjugated molecules. Thus, for conjugated polymers, disruptions to this continuous order such as structural and/or conformational defects may have a large influence on the hyperpolarizabilities. We have performed semiempirical electronic structure calculations for a series of model compounds such as polyenes and polyphosphazenes to determine the effects of structural and conformational defects on the hyperpolarizabilities. Briefly, we find that structural and conjugational defects enhance the hyperpolarizabilities of polyenes, but have little influence on polyphosphazenes due to their limited π delocalization. 10 refs., 5 figs.

13128 (PNL-SA–18622) **Vibrational frequencies for model silicates: Extensions beyond molecular properties.** Ferris, K.F.; Risser, S.M. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 8p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-901105–103: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008828. Source: OSTI; NTIS; GPO Dep.

The investigation of surface properties for ceramic materials often focuses on molecular properties, both in terms of model systems and methods. Typically, we use molecular species (i.e. SiO_4H_4, H_3SiOH) to represent silica surfaces, often resulting in poor prediction of absorption phenomena. Dielectric effects, even when approximated by electrostatic and polar interactions, can have significant effects on the charge distribution and surface absorption characteristics of model molecular complexes. In this paper, we report on the effect of the surrounding matrix on the harmonic vibrational frequencies by employing reaction field techniques in electronic structure calculations. Comparisons of molecular-based to reaction field affected properties will be made to illustrate the extensions of the molecular to the extended network domain. 9 refs., 1 fig., 4 tabs.

13129 (SAND–89-1023) **An evaluation of the effects of varying composition and processing on several encapsulating resins.** Wischmann, K.B.; Thomas, E.V. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009101. Source: OSTI; NTIS; GPO Dep.

This investigation describes how a statistically designed experiment can be useful to characterize the relationship between a

fundamental material property such as the glass transition temperature, Tg, and various processing parameters, e.g. composition, cure time, and temperature. To illustrate, formulation weighing errors can have a dramatic affect on material properties such as thermal, mechanical, and electrical properties. The glass transition temperature was selected for monitoring because it represents the materials state of cure and it is relatively easy to determine. Specifically, EPON 828 systems cured with diethanolamine and Shell Z, respectively, were investigated plus a mixture of the latter that employed aluminum oxide as a filler. This investigation showed that Tg changed very little with cure temperature in the DEA system compared to Shell Z, whereas the latter system appeared to display synergistic effects contrary to the DEA system. In the filled formulation, loading level had very little effect on Tg. The significance of this study is that the relationship between Tg, the composition and processing factors can be used to help diagnose the cause of misprocessed material. 2 refs., 11 figs., 3 tabs.

13130 (SAND–90-2540C) **Contamination reduction program: A means to instituting ultra pure processing.** Cheung, S.D. (Union Carbide Industrial Gases, Inc., Tarrytown, NY (USA)); Francis, A.W. Jr.; Conley, W.R.; Brown, N.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9010152–2: Microcontamination '90 conference, Santa Clara, CA (USA), 30 Oct - 1 nov 1990). Order Number DE91008183. Source: OSTI; NTIS; GPO Dep.

ULSI manufacturing technologies have resulted in the development of Ultra-Pure Processing (UPP) capabilities for the world-wide semiconductor industry. The primary goal of Ultra Pure Processing is the elimination of extraneous contaminants. both gaseous and particulate, from the wafer process environment. This calls for a comprehensive approach to the design, operation. and maintenance of semiconductor process equipment. Through UPP one may reduce the number of uncontrolled variables within a system enhancing implementation of Statistical Process Control on the process environment within the tool (in situ). Greater control over the process environment translates into increased product quality, manufacturability, throughput and yield. Instituting UPP requires the capability of monitoring contaminants in the process environment a well as a systematic approach to isolating and eliminating contamination sources. Ultra Pure Processing can result from a Contamination Reduction Program. Presented here are the results from a Contamination Reduction Program performed on a state-of-the-art vertical thermal process reactor (VTR). 8 figs., 5 tabs.

13131 (SAND–91-0232C) **Dip coating of sol-gels.** Schunk, P.R.: Hurd, A.J.: Brinker, C.J. Sandia National Labs.. Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE. Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105127–1: 44. annual conference of the imaging science and technology, St. Paul. MN (USA). 12-17 May 1991). Order Number DE91007571. Source: OSTI; NTIS; GPO Dep.

Dip coating is the primary means of depositing sol-gel films for precision optical coatings. Sols are typically multicomponent systems consisting of an inorganic phase dispersed in a solvent mixture. with each component differing in volatility and surface tension. This, together with slow coating speeds (<1cm/s). makes analysis of the coating process complicated; unlike most high-speed coating methods, solvent evaporation, evolving rheology, and surface tension gradients alter significantly the fluid mechanics of the deposition stage. We set out to understand these phenomena with computer-aided predictions of the flow and species transport fields. The underlying theory involves mass, momentum, and species transport on a domain of unknown shape, with models and constitutive equations for vapor-liquid equilibria and surface tension. Due accounting is made for the unknown position of the free surface, which locates according to the capillary hydrodynamic forces and solvent loss by evaporation. Predictions of the effects of mass transfer, hydrodynamics, and surface tension gradients on final film thickness are compared with ellipsometry measurements of film thickness on a laboratory pilot coater. Although quantitative agreement is still lacking, both experiment and theory reveal that the film profile near the drying line takes on a parabolic shape. 2 refs., 2 figs.

13132 (SAND–91-0292C) **UV cured epoxy resin coatings.** Wischmann, K.B. Sandia National Labs., Albuquerque, NM (USA). [1991]. 5p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910279–7: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991). Order Number DE91008180. Source: OSTI; NTIS; GPO Dep.

This report discusses the cycloaliphatic epoxide that is UV cured to create protective coatings. Mechanical and electrical properties are briefly discussed. (JDL)

13133 (SVF–380) **Corrosion studies of porcelain enamel coated water-heaters.** Svensson, B.M. (Studsvik Energy, Nykoeping (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Nov 1990. 72p. (In Swedish). (STUDSVIK-EX–90-16). Order Number DE91753061. Source: OSTI; NTIS (US Sales Only).

Laboratory tests have been performed in order to investigate the dissolution rate of porcelain enamel coated steel when exposed with and without cathodic protection. The influence of temperature and tap water quality was studied. Tests have also been made on reduced enamel coatings and on damaged enameled surfaces. One water-heater has been tested regarding the need of cathodic protecting current. The enamel coating showed higher dissolution rate when exposed to tap water with cathodic protection than without. Adjacent to damaged areas the dissolution of the enamel was increased under deposits. The dissolution rate of the enamel was doubled by an increase of temperature of 14-17 degrees centigrade. An increasing demand for cathodic protection (protecting current) was noted for the reduced enamel coatings. The consumption of the sacrificial anode (magnesium AZ 31) was mainly caused by corrosion if the amount of defects in the enameled surface was normal. That corrosion did not change with the temperature within the tested range. The enamel coating of the water-heater showed initial stages of corrosion in those areas where severe corrosion attacks have occurred during operation. (author).

13134 (UCRL-CR–105858-Summ.) **Development of low density silica aerogel as a capture medium for hyper-velocity particles: Summary report, FY90.** Hrubesh, L.W.; Poco, J.F. Lawrence Livermore National Lab., CA (USA). 1 Dec 1990. 14p. Sponsored by USDOE, Washington. DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91008563. Source: OSTI; NTIS; GPO Dep.

The authors successfully demonstrated the production of monolithic bricks of transparent silica aerogel (2.5 cm X 4.5 cm X 16 cm) with densities as low as 0.003 g/cm^3. They have characterized the microstructure of these new ultra-low density aerogels, and determined that they are polymeric-like having crosslinked chains of silica as compared with the colloidal-like silica formed with the conventional sol-gel approach. They have determined that the new ultra-low density aerogels have a higher compressive modulus than would be expected from an extrapolation from the higher density aerogels, and they are typically 15% more transmissive than conventional aerogels for the wavelength range from 350nm to 800nm. The authors have developed a new method of casting regular shaped aerogels using silicone rubber molds. This new method eliminates irregular surfaces, for example the raised surface caused by a meniscus, in prior methods. Flat, and nearly parallel sides are obtained with the new method. They delivered 26 tiles of aerogels for the EURECA experiment. The nominal density of each tile was about 0.06 g/cm^3. Twenty of the tiles had dimensions of approximately 1.8in X 1.8in X 0.2in. with flat sides. The remaining six tiles had dimensions of approximately 1.8in X 3.5in X 0.2in. All tiles were shipped from LLNL to the University of Washington before September 30, 1990. 5 figs.

13135 (UCRL-JC–103740) **A sol-gel route to very high porosity silica aerogels.** Hrubesh, L.W.; Tillotson, T.M.; Poco, J.F. Lawrence Livermore National Lab., CA (USA). 1 Feb 1991. 14p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910291–2: 5. international conference on ultrastructure processing of ceramics, glasses, composites and advanced optical materials, Orlando, FL (USA), 17-21 Feb 1991). Order Number DE91008501. Source: OSTI; NTIS; GPO Dep.

This report discusses the preparation and characterization of very high porosity silica aerogels. The data presented here suggests a microstructure for the very high porosity silica aerogel that differs from the bead-like structure proposed for single-step, base catalysed TMOS aerogels. The data is consistent with an interlinked polymer chain-like structure, with an average chain diameter of 2-3nm and an average chain length >15nm. The increased transparency of these new aerogels also indicates that they have very small particles and uniform pores less than 50nm.

13136 (UCRL-JC–106127) **Nondestructive imaging of materials microstructure using x-ray tomographic microscopy.** Kinney, J.H. (Lawrence Livermore National Lab., CA (USA)); Saroyan, R.A.; Nichols, M.C.; Bonse, U.; Stock, S.R.; Breunig, T.M.; Guvenilir, A. Lawrence Livermore National Lab., CA (USA). Nov 1990. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-901105–97: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91008505. Source: OSTI; NTIS; GPO Dep.

A technique for nondestructively imaging microstructures of materials in situ, especially a technique capable of delineating the time evolution of chemical changes or damage, will greatly benefit studies of materials processing and failure. X-ray tomographic microscopy (XTM) is a high resolution, three-dimensional inspection method which is capable of imaging composite materials microstructures with a resolution of a few micrometers. Because XTM is nondestructive, it will be possible to examine materials under load or during processing, and obtain three-dimensional images of fiber positions, microcracks, and pores. This will allow direct imaging of microstructural evolution, and will provide time-dependent data for comparison to fracture mechanics and processing models. 23 refs., 8 figs.

13137 (UCRL-JC–106518) **Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen.** Balooch, M.; Siekhaus, W.J.; Tench, R.J. Lawrence Livermore National Lab., CA (USA). Jan 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910186–2: Engineering Foundation conference, Santa Barbara, CA (USA), 1-11 Jan 1991). Order Number DE91008569. Source: OSTI; NTIS; GPO Dep.

Scanning tunneling microscopy (STM) is used to study the kinetics of graphite gasification by oxidation and the morphology of platinum catalyzed hydrogen reaction. The graphite sample is heated conventionally for long-term measurement at low to moderate temperatures, or by laser with millisecond exposure times at high temperatures. The oxidation of graphite takes place on step edges, domain boundaries and on individual dislocation or impurity sites on terraces. The reaction at individual reaction sites on the terraces leads either to removal of "disks" of graphite two monolayers deep, or to removal of cones of graphite. The reactivity of a particular site is determined (over twelve orders of magnitude) by measuring the edge's recession velocity at the site. The rate of gasification of graphite by ozone is orders of magnitude higher than gasification by oxygen in air at a given temperature. Clusters of platinum deposited on graphite act as catalysts to dissociate molecular hydrogen and thus enhance the gasification. Discrete clusters stay with the receding carbon site, resulting in channels on the graphite surface. 9 refs., 7 figs.

13138 (UCRL-JC–106520) **Organic aerogels: A new type of ultrastructured polymer.** Pekala, R.W.; Alviso, C.T.; LeMay, J.D. Lawrence Livermore National Lab., CA (USA). 1 Feb 1991. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910291–1: 5. international conference on ultrastructure processing of ceramics, glasses, composites and advanced optical materials, Orlando, FL (USA), 17-21 Feb 1991). Order Number DE91008500. Source: OSTI; NTIS; GPO Dep.

Organic aerogels with different ultrastructures can be successfully synthesized from the aqueous sol-gel polymerization of (1) resorcinol with formaldehyde or (2) melamine with formaldehyde. In addition, RF aerogels can be pyrolyzed in an inert atmosphere to give vitreous carbon aerogels. The [resorcinol]/[sodium carbonate] ratio is the major variable in the RF polymerization while pH and acid type regulate the MF polymerization. Mechanical property, TEM, and surface area data provide evidence that organic aerogels are similar to their silica counterparts. Based upon these data, we are continuing to explore commonalities between inorganic and organic aerogels so that a universal model might be developed for the structure and properties of these unique materials. Such a model would have a major impact upon the materials science community by opening up new routes for the nanodesign of microporous materials with novel compositions, ultrastructures, and properties. 33 refs., 8 figs.

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Refer also to citation(s) 12551, 12872

13139 (PNL-SA–18847) **Graphical user interfaces in computational chemistry.** Bair, R.A. Pacific Northwest Lab., Richland, WA (USA). Sep 1990. 51p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-9009303–1: Workshop on graphical user interfaces in computational chemistry, Seattle, WA (USA), 5-7 Sep 1990). Order Number DE91009116. Source: OSTI; NTIS; GPO Dep.

The Workshop on Graphical User Interfaces in Computational Chemistry, was intended as an opportunity for a small group of interested computational chemists and computer scientists to: exchange ideas, collectively examine aspects of the interface and the interface development process, explore the possibilities for collaborative efforts, and to consider directions for future development while this field is still in it's infancy. The following topics, which were covered in greater depth in working groups, included: needs for graphical user interfaces in computational chemistry; the chemistry user interface environment; the interface design process in computational chemistry; software design tools for graphical user interfaces; and determining the characteristics of a successful interface. Each working group reported its results to the workshop as a whole for debate and discussion. The analysis, conclusions and recommendations of these working groups are brought together in this report along with some background material. This report presents the mission of the Environmental and Molecular Sciences Laboratory and its Molecular Science Research Center (MSRC), a summary of the workshop conclusions, and the detailed reports from each of the five working groups listed above.

4001 Analytical and Separations Chemistry

Refer also to citation(s) 12322, 12449, 12455, 12471, 12472, 12554, 12647, 12753, 13022, 13095, 13118, 13119, 13121, 13196, 13500, 13505, 13528, 13531, 13611, 13614, 13830

13140 (ANL/ACL–90/2) **Analytical chemistry laboratory: Progress report for FY 1990.** Argonne National Lab., IL (USA). Dec 1990. 50p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91008986. Source: OSTI; NTIS; GPO Dep.

This purpose of this report is to summarize the activities of the Analytical Chemistry Laboratory (ACL) at Argonne National Laboratory (ANL) for Fiscal Year 1990. The ACL has four technical groups – Chemical Analysis, Instrumental Analysis, Organic Analysis, and Environmental Analysis. The Chemical Analysis Group uses wet-chemical and instrumental methods for elemental, compositional, and isotopic analyses of solid, liquid, and gaseous samples and provides specialized analytical services. The Instrumental Analysis Group uses nuclear counting techniques in radiochemical analyses over a wide range of sample types from low-level environmental samples to samples of high radioactivity. The Organic Analysis Group uses a number of complementary techniques to separate and to quantitatively and qualitatively analyze complex organic mixtures and compounds at the trace level, including synthetic fuels, toxic substances, fossil-fuel residues and emissions, pollutants, biologically active compounds, pesticides, and drugs. The Environmental Analysis Group performs analyses of inorganic environmental and hazardous waste and coal samples.

13141 (CONF-910278–3) **Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap**

mass spectrometry. Wise, M.B.; Ilgner, R.H.; Buchanan, M.V.; Guerin, M.R. Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA); National Cancer Inst., Bethesda, MD (USA). DOE Contract AC05-84OR21400. From 2. international symposium on field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (USA); 12-14 Feb 1991. Order Number DE91008885. Source: OSTI; NTIS; GPO Dep.

Direct thermal desorption of analytes into an ion trap mass spectrometer (ITMS) is being investigated as a technique for the rapid screening of a wide variety of samples for target semivolatile organic compounds. This includes the direct detection of drugs in physiological fluids, semivolatile organic pollutants in water and waste samples, and air pollutants collected on sorbent cartridges. In order to minimize the analysis time, chromatographic separation is not performed on the sample prior to introduction into the ITMS. Instead, selective chemical ionization and tandem mass spectrometry (MS/MS) are used achieve the specificity required for the target analytes. Detection limits are typically 10–50 ppb using a 1 uL aliquot of a liquid sample without preconcentration. Sample turn-around time is 2 to 5 minutes and 3 to 5 target analytes can be quantitatively determined simultaneously. 6 figs.

13142 (CONF-9104185–1) **A laboratory-scale burner seeded with potassium for calibration of potassium emission/absorption instruments.** Bouchillon, C.W. Mississippi State Univ., Mississippi State, MS (USA). Diagnostic Instrumentation and Analysis Lab. [1991]. 6p. Sponsored by USDOE,. DOE Contract AC02-80ET15601. From Combustion fundamentals and application conference; Nashville, TN (USA); 21-24 Apr 1991. Order Number DE91007217. Source: OSTI; NTIS; GPO Dep.

In magnetohydrodynamic (MHD) power systems, potassium may be used to enhance the electrical conductivity of the high temperature products of combustion. In order to better evaluate the performance of MHD generators, it is desirable to be able to measure the distribution of the electrical conductivity of the gases throughout the channel through which the hot gases are passing. One such system is based on the emission/absorption spectra of potassium as a function of temperature. Diagnostic instruments, based on the emission/absorption characteristics of potassium in a flame or plasma require calibration in known temperature and potassium concentration conditions. A laboratory-scale hydrogen/oxygen burner which is seeded with gaseous potassium has been designed, fabricated, and operated for the purpose of providing a calibration facility for the potassium emission/absorption spectrographic (PE/AS) instrument. A nickel block was machined appropriately to provide separate flows of oxygen, hydrogen, and potassium vapor in a hot nitrogen stream mixed with hydrogen. A potassium evaporator was designed and fabricated to allow hot nitrogen gas to bubble through hot molten potassium to provide a known mass fraction of potassium to the resultant flame. The vapor pressure variation of the potassium with temperature was used to predict the amount of potassium carried to the flame by assuming that the hot nitrogen stream resulted in a saturated mixture as it bubbled through the heated molten potassium. Operational aspects as well as safety considerations in the operation of this burner are described. 10 refs., 1 fig.

13143 (CONF-9104192–1) **Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules.** Hettich, R.L.; Buchanan, M.V. Oak Ridge National Lab., TN (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Workshop on laser ablation: mechanisms and application; Oak Ridge, TN (USA); 8-10 Apr 1991. Order Number DE91008877. Source: OSTI; NTIS; GPO Dep.

The recent advances in matrix-assisted laser desorption mass spectrometry have indicated tremendous potential for the analysis of large biomolecules (MW > 100,000 Daltons) such as peptides and oligonucleotides. To achieve soft ionization for these large molecules, a matrix compound such as nicotinic acid is mixed with a small amount of the biological analyte. This matrix helps absorb the laser radiation and subsequently reduce the fragmentation of the analyte ions. The objective of our research is to develop and refine laser desorption Fourier Transform Mass Spectrometry (FTMS) for the detailed structural characterization of biomolecules at the isomeric level. This presentation will focus on the development and application of matrix-assisted laser desorption FTMS for the examination of normal and modified oligonucleotides. Current research involves investigation and optimization of experimental parameters which will extend the mass range for the FTMS experiments. 4 refs., 1 fig.

13144 (DOE/ER/13327–T2) **Studies of metal ammonia interactions with aromatic substrates: Final report, January 1, 1988–August 31, 1990.** Rabideau, P.W. Indiana Univ.-Purdue Univ., Indianapolis, IN (USA). [1990]. 10p. Sponsored by USDOE,. DOE Contract FG02-85ER13327. Order Number DE91008146. Source: OSTI; NTIS; GPO Dep.

Dissolving metal reduction and reductive alkylation reactions are important to coal chemistry, since they promote the solubilization and depolymerization of coal. Solubilization is important to liquefaction, as well as to the characterization of coal structure, since the soluble fractions can be analyzed spectroscopically. This research program has focussed on a better understanding of the reduction pathway using polynuclear aromatics (PAs) as model compounds. Accomplishments in the last three years include reduction studies of polynuclear aromatics separated by (1) inactive spacers (methylene groups), or (2) active spacers (benzene rings). In the first category, we studied the reduction of dinaphthylethanes in ether and ammonia solvents, and have learned that cleavage of the ethane bridge only occurs at higher temperatures regardless of solvent. In the second case, we investigated a number of dinaphthylbenzenes and found that, unlike the related terphenyls, these compounds show no propensity for inner ring reduction. A second area of research is concerned with the conformational analysis of hydroaromatic compounds. We have concluded two studies providing structural information about 9,10-dihydroanthracenes using nuclear magnetic resonance and theoretical calculations. Additional studies not yet concluded involve anion structure on mono- and dianions derived from PAs. This includes preferred conformations, ion triplets and solvation. 4 refs.

13145 (DOE/ER/13480–1) **Dynamics and kinetics of molecular systems: Progress report, February 1, 1987–July 20, 1989.** Rabitz, H. Princeton Univ., NJ (USA). Dept. of Chemistry. [1989]. 22p. Sponsored by USDOE,. DOE Contract FG02-86ER13480. Order Number DE91007457. Source: OSTI; NTIS; INIS; GPO Dep.

The enclosed Progress Report covers $2\frac{1}{2}$ years under the Department of Energy contract #DE-FG02-86ER13480-A0001. During this period of time, a number of closely interrelated topics were pursued in the general area of molecular dynamics and chemical kinetics. One prevailing theme of this research has concerned studies to reveal the interrelationship between input-output information at various levels of dynamics and kinetics. Exploration of this basic issue has lead to the author continuing development and implementation of sensitivity analysis techniques. The theoretical tools involved have been illustrated for numerous chemical/physical systems revealing a number of interesting and, in some cases, unusual relations between laboratory observables and underlying fundamental input information. The research summary below consists of abstracts from papers and manuscripts that were supported under this contract. 27 refs.

13146 (DOE/ER/13507–6) **Synthesis and analysis of novel polymers with potential for providing both high permselectivity and permeability in gas separation applications: Progress report, December 1989–December 1990.** Koros, W.J.; Paul, D.R. Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering. 5 Jan 1991. 8p. Sponsored by USDOE,. DOE Contract FG05-86ER13507. Order Number DE91008283. Source: OSTI; NTIS; GPO Dep.

We have achieved the following experimental, analytical and publication objectives consistent with our project goal to develop advanced materials for gas separation membrane applications. Synthesized and partially completed characterization of a group of additional polysulfone materials beyond those proposed in the renewal proposal to test ideas developed in the course of the work. Characterized on additional polycarbonate material, spirobiindane polycarbonate, in cooperation with General Electric Corporation

who provided the material at our request to test ideas developed in the course of the work. Synthesized and characterized the first two members in the systematic family of polyesters described in our renewal proposal. Also, based on attractive results with the spirobiindane polycarbonate, we have synthesized two members of the polyester family based on this monomer to demonstrate the desirable aspects of the simultaneous disruption of packing and suppression of molecular motion caused by the spirobiindane group. 8 refs., 2 tabs.

13147 (DOE/ER/13591–5) **Polymer-based separations: Synthesis and application of polymers for ionic and molecular recognition: Annual performance report, August 1, 1990–July 31, 1991.** Alexandratos, S.D. Tennessee Univ., Knoxville, TN (USA). Apr 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-86ER13591. Order Number DE91009516. Source: OSTI; NTIS; GPO Dep.

The object of this research is to develop an understanding of the mechanisms by which polymers interact with ions and molecules in solution and, in so doing, design polymers with high levels of selectivity for target substrates. Research thus continues for the synthesis of polymers with enhanced ionic and molecular recognition. Polymers studied and discussed include phosphinic acid resins, dimethyl amine/phosphinic acid, phosphonate monoester/diester resins, and sulfonic acid resins. 6 refs.

13148 (DOE/ER/13792–4) **Spectroscopy and reaction dynamics of collision complexes containing hydroxyl radicals: Progress report, June 1, 1990–May 31, 1991.** Lester, M.I. Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Chemistry. Feb 1991. 5p. Sponsored by USDOE,. DOE Contract FG02-87ER13792. Order Number DE91007980. Source: OSTI; NTIS; GPO Dep.

Stimulated emission spectroscopy has been used to measure the frequencies of the intermolecular bending and stretching modes in the ground electronic state of the OH-Ar complex correlating with OH ($X\ ^2\Pi$) + Ar ($^1S_0$). The results are compared with those predicted using an ab initio potential energy surface. Encouraging agreement between experiment and theory is obtained, particularly for the bending modes. 8 refs.

13149 (ENEA-RT-AMB–90-14) **Polycyclic aromatic hydrocarbons in carbon black: Gas chromatography-mass spectrometry and HPLC.** Di Palo, C.; Caricchia, A.M. ENEA, Casaccia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo. Oct 1990. 22p. (In Italian). (RT/AMB–90-14). Order Number DE91752932. Source: OSTI; NTIS (US Sales Only); INIS.

'Carbon black', the product of incomplete combustion or thermal decomposition of hydrocarbons in the vapour phase, is produced in large amounts in the world and utilized in the rubber and ink industry, electric insulating material, etc. Its interest, as a pollution agent, lies in its being a respirable particulate and in its ability to adsorb many organic compounds. Among adsorbed organic matter, the polycyclic aromatic hydrocarbons (PAHs) are the most studied, because of the carcinogenicity of some of the components. This work consists of two parts: the first contains some fundamental information about carbon black; in the second part, an analytical procedure for PAH determination in carbon black is described. Five samples of 'furnace' carbon black, containing several PAHs in the ppb range of concentration, were analysed by gas chromatography-mass spectrometry (GC-MS) and high performance liquid chromatography (HPLC).

13150 (ENEA-RT-INN–90-10) **Electronic spreadsheet for calculation of solvent extraction cascade concentrations.** Casarci, M.; Marrocchelli, A. ENEA, Casaccia (Italy). Centro Ricerche Energia. 1990. 32p. (In Italian). (RT/INN–90-10). Order Number DE91752914. Source: OSTI; NTIS (US Sales Only); INIS.

This paper explains how the EXCEL spreadsheet (by MICROSOFT, USA) is applied to calculate concentrations in solvent extraction cascades. This method allows the assessment of the final equilibrium concentrations for each single stage. The technique applies very easily to solvent extraction process schemes such as the separation and purification of rare earths, because it takes into account the effects of partial and total reflux both for the organic and aqueous phases. A comparison, pointing out advantages and disadvantages, is made between the EXCEL and SOLVEX programs.

13151 (ETDE-IT–91-05) **European intercomparison of vegetable standard reference materials (INAA and non-nuclear spectrochemical techniques evaluation).** Moauro, A.; Carconi, P.L. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettoriali di Base. Oct 1990. 19p. (CONF-9010328–2: International conference on activation analysis and its applications, Beijing (China), 15 Oct 1990). Order Number DE91752898. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at the international conference on activation analysis and its application (Beijing, 15-19 Oct 1990)

The paper reports INAA (Instrumental Neutron Activation Analysis) results obtained through the analysis of 11 vegetable samples proposed as European reference standards in nutritional, agricultural and analytical studies. A comparison is also made with the data obtained from 38 European labs in which spectrochemical methods (ICP atomic absorption, X-ray fluorescence, etc.) were used. The usefulness of INAA is stressed, particularly for cases in which more traditional methods are not sensitive enough for microelements that are important markers of toxic and polluting substances. To this class belong lanthanides and other rare elements (Sc, Cs, Rb) that can be used to fingerprint the provenance soil and evaluate sample homogeneity.

13152 (GKSS–90/E/18) **Concentration of gold in whole blood, plasma, urine, feces, and hepatic bile following a single peroral administration of the antirheumatic agent Auranofin, determined by instrumental neutron activation analysis (INAA).** Schnier, C. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik); Wedderin, T.; Jablonski, R.; Niedergesaess, R.; Benn, H.P. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). 1990. 87p. (In German). Order Number DE91754878. Source: OSTI; NTIS (US Sales Only); INIS.

In antirheumatic therapies, gold containing agents have proved to be beneficial. In this study the distribution of gold in the different elimination routes in the human body was measured after a single oral application of a gold containing agent. Seven patients, whose gall bladders had just been removed surgically, received 5 tablets RIDAURA containing a total amount of 4.35 mg gold in the chemical compound Auranofin. In the following 13 days samples of whole blood, plasma, urine, feces and hepatic bile (the latter only within 7 days) were taken and analysed using the method of instrumental neutron activation analysis (INAA). After a two-hour-irradiation with neutrons in the Research Reactor Geesthacht (FRG) and after a waiting time of 5-10 days, the limit of detection for gold was about 0.2 ng, and after a three-day-irradiation of the bile samples about 0.03 ng. In whole blood and plasma, the gold concentrations reached the maximum values (140 and 170 ng/ml resp.) after about 2 h p.a., and decreased then with a biological half-life of 7 d and about 20 d resp.. In urine and bile, the maximum gold values (about 43 and 65 ng/ml) were reached after 16 h. The gold concentration decreased in urine with half-lives of 63 d, and in bile, first with 21 h and later, in the end phase, with 6.5 d. Further elements particularly in bile were determined. (orig.) With 9 figs., 8 tabs., annex of tables.

13153 (INIS-mf–12796, pp. 213-218) **Application of capillary isotachophoresis in analysis of decontamination solutions and radioactive liquid wastes.** Pelech, J. (Jaderna Elektrarna, Dukovany (Czechoslovakia)); Nebrensky, S. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

Isotachophoresis, a method enabling mixtures of ionogenic materials in solutions to be analyzed, provides in several minutes data on the qualitative and quantitative sample composition, the error of determination ranging between 1 and 3%. The method can be used in quantitating tens of ng of compounds. It differs from classical electrophoresis in the use of two electrolytes, viz., the leading and the terminating electrolytes. It can be used in nuclear power

plants in analyses of acid decontamination solutions, liquid radioactive wastes, etc. (M.D.). 2 figs.

13154 (IS-T–1449) **Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation.** Christensen, P.L. Ames Lab., IA (USA). Jan 1991. 131p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91008926. Source: OSTI; NTIS; GPO Dep.

Polarization properties of light can be exploited to develop more selective spectroscopic methods of chemical analysis. Modulation of polarization coupled with lock-in detection provides a powerful detection scheme with improved detectabilities. This dissertation demonstrates the importance of optical design in systems utilizing polarization modulation. In Chapter 2, optimization of modulation frequency and efficiency and simplification of optical design led to a 10-fold improvement in the detectability for sodium atoms by laser polarization spectroscopy. The limit of detection for sodium atoms by this method is 2 ng/l. The increased S/N at 150 kHz allowed operation in the dispersion mode and subsequently provided linear calibration curves. Chapters 3 and 4 present the first studies of fluorescence-detected circular dichroism (FDCD) for on-column detection in capillary electrophoresis (CE). Detection by direct fluorescence (FL) is carried out simultaneously and provides a convenient means of evaluating the FDCD performance. Modulation efficiency and balance and preservation desired polarization are discussed in detail and are shown to have great influence on the selectivity attainable by FDCD. Among techniques that sense optical activity, FDCD provides superior detectability on an absolute scale because it is suitable for picoliter detection volumes. Optical activity signals were observed for riboflavin (LOD = 0.2 fmol) and for less than 50 fmol of some fluorescein isothiocyanate-amino acid derivatives (FTC-amino acids) by FDCD/FL-CE. The major chapters have been indexed separately for inclusion on the data base.

13155 (KFK–4775) **Stripping voltammetric behavior of technetium at various chemically modified electrodes.** Dick, R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie. Sep 1990. 153p. (In German). (PWA–34/90). Order Number DE91759270. Source: OSTI; NTIS (US Sales Only); INIS.

In monitoring of nuclear processing plants and storage facilities the necessity arises of assaying traces of the artificial radioactive element technetium. The oxidation states IV and VII are of particular interest. Stripping voltammetry is among the methods of assay which are suited for this purpose. It allows an enhanced selectivity to be achieved by preconcentration of the analyte and of an oxidation state of the analyte, respectively, at the electrode used. This specific enrichment is successful after appropriate chemical modification of the electrode through immobilization of a Tc-specific reagent. When various approaches of chemical modification of a glassy carbon electrode were examined, the tetraphenylarsonium chloride extractant, which is highly selective with respect to technetium, proved to be the best suited reagent, capable of fixation both by ionic and by covalent bonding on an electrodeposited polymer film. For ionic immobilization the reagent was reacted to m-sulfophenyltriphenyl arsonium and then bound to a copolymer of vinylferrocene and vinylpyridine, which had been provided with cations. It was possible to enrich Tc(VII) at such an electrode and to determine it by stripping voltammetry down to a concentration of 1×10^{-8} M after 5 minutes enrichment time. (orig./EF).

13156 (KURRI-TR–336, pp. 31-36) **Radial distribution of several trace elements in stems of eight woods species.** Taneda, Kenzoh (Iwate Univ., Morioka (Japan). Faculty of Agriculture); Ota, Michikazu; Nagano, Seizoh; Katayama, Yukio; Okada, Naoki. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jun 1990. (In Japanese). (CONF-8911275–: 3. intensive seminar on 'tree rings', Kumatori (Japan), 29-30 Nov 1989). In *Papers presented at the intensive seminar on 'tree rings'.* 99p. Order Number DE91745057. Source: OSTI; NTIS (US Sales Only); INIS.

Instrumental neutron activation analysis (INAA) was used to determine the radial distribution of the trace element in domestic woods of eight species. Matched samples were exposed to a thermal neutron flux of 1 to 1.5 x 10^{12} n/cm^2/sec for 1 to 3 min. Following a little decay period, the activity of the samples was measured for 200 sec using a Ge(Li) spectrometer system. The following conclusions were made: (1) Eight trace elements (some few were missing) were positively identified: Ca, K, Mg, Cl, Na, Mn, Al and V. A wide range of values was evident among the eight wood species: Sugi, Buna, Sawagurumi, Tochinoki, Konara, Akamatsu, Katsura and Kiri. Individual ranges of concentration were found to be: Ca, 354 to 1907 ppm; K, 58 to 2563 ppm; Mg, 24 to 600 ppm; Cl, .06 to 513 ppm; Na, 2 to 299 ppm; Al, 1 to 18 ppm; Mn, .4 to 79 ppm; and V, .002 to .3 ppm. (2) Although the distribution of the elements has the large fluctuation of concentration, its patterns can be classified into three types; gradual decrease, gradual increase and almost similar levels from the pith to the cambium. (3) Differences in the order of mean concentrations of the elements among the wood species were few. (4) Although similar patterns of distribution of the trace elements are scarcely observed in the same element among the wood species, they are sometimes observed in the same wood species among a few elements. (author).

13157 (KURRI-TR–336, pp. 37-44) **The application of carbon-isotope measurements to dendro- and xylem-chronology.** Yonenobu, Hitoshi (Nagoya Univ. (Japan). Faculty of Agriculture); Hattori, Yoshiaki; Kikata, Yoji; Mitsutani, Takumi; Nakamura, Toshio. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jun 1990. (In Japanese). (CONF-8911275–: 3. intensive seminar on 'tree rings', Kumatori (Japan), 29-30 Nov 1989). In *Papers presented at the intensive seminar on 'tree rings'.* 99p. Order Number DE91745057. Source: OSTI; NTIS (US Sales Only); INIS.

We measured $^{14}C/^{13}C$ Ratio of the Teak. The ^{14}C excess, which reflects the execution of the tropospheric nuclear tests, is stamped in the Teak trunk. In place of the annual rings this stamp can estimate the xylem-chronologies and more accurate growth rates of tropical trees which have no annual rings. And replacing the shot-pinning method we can estimate the growing period in an annual ring formed especially in 1963-1966, when the ^{14}C concentration in the tropospheric air changes dramatically. And we measured ^{14}C-chronologies of the annual rings of O-Hinoki, ^{14}C-chronologies agree well with dendrochronologies for the past 600 years. And the ^{14}C chronologies support more determinative cross-dating of the archaeological samples. (author).

13158 (LA-UR–91-434) **Hand-held gas chromatography-ion mobility spectrometry for on-site analysis of complex organic mixtures in air or vapors over waste sites.** Bell, S.C. (Los Alamos National Lab., NM (USA)); Eiceman, G.A. Los Alamos National Lab., NM (USA). [1991]. 13p. Sponsored by Department of Defense, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910278–2: 2. international symposium on field screening methods for hazardous wastes and toxic chemicals. Las Vegas, NV (USA), 12-14 Feb 1991). Order Number DE91008579. Source: OSTI; NTIS; GPO Dep.

The strengths of Ion mobility spectrometry (IMS) are low detection limits, a wide range of application, and simplicity of design and operation. The gentle ionization processes used in IMS impart a measure of selectivity to its response. However, atmospheric pressure chemical ionization with compounds of comparable proton affinities leads to mobility spectra for which interpretive and predictive models do not exist. An alternative approach for the analysis of complex mixtures with IMS is the use of a separation device such as a gas chromatograph (GC) as an inlet. Results suggest that an IMS cell temperature of ca. 150° to 175°C provided mobility spectra with suitable spectral detail without the complications of ion-molecule clusters or fragmentation. Significant fluctuation in peak heights were observed over a 30 day test period. Neural network pattern identification techniques were applied to data obtained at room temperature and at 150°. Results showed that spectral variables within compound classes as insufficient to distinguish related compounds when mobility data was obtained using the commercial room temperature IMS cell. Similar but less severe difficulty was encountered using the 150° data. 5 refs., 3 figs., 2 tabs.

13159 (NBL–323) **The effect of ion-exchange purification on the determination of plutonium at the New Brunswick Laboratory.** Mitchell, W.G.; Spaletto, M.I.; Lewis, K.; Soriano, M.D.; Smith, M.W. USDOE New Brunswick Lab., Argonne, IL (USA). Jul 1990. 54p. Sponsored by USDOE,. Order Number DE91009061. Source: OSTI; NTIS; INIS; GPO Dep.

The method of plutonium (Pu) determination at the Brunswick Laboratory (NBL) consists of a combination of ion-exchange purification followed by controlled-potential coulometric analysis (IE/CPC). The present report's purpose is to quantify any detectable Pu loss occurring in the ion-exchange (IE) purification step which would cause a negative bias in the NBL method for Pu analysis. The magnitude of any such loss would be contained within the reproducibility (0.05%) of the IE/CPC method which utilizes a state-of-the-art autocoulometer developed at NBL. When the NBL IE/CPC method is used for Pu analysis, any loss in ion-exchange purification (<0.05%) is confounded with the repeatability of the ion-exchange and the precision of the CPC analysis technique (<0.05%). Consequently, to detect a bias in the IE/CPC method due to the IE alone using the IE/CPC method itself requires that many randomized analyses on a single material be performed over time and that statistical analysis of the data be performed. The initial approach described in this report to quantify any IE loss was an independent method, Isotope Dilution Mass Spectrometry; however, the number of analyses performed was insufficient to assign a statistically significant value to the IE loss (<0.02% of 10 mg samples of Pu). The second method used for quantifying any IE loss of Pu was multiple ion exchanges of the same Pu aliquant; the small number of analyses possible per individual IE together with the column-to-column variability over multiple ion exchanges prevented statistical detection of any loss of <0.05%. 12 refs.

13160 (RT-DSD–09) **Determination of plutonium 241 in solutions of nuclear wastes.** Raymond, A.; Bilcot, J.B.; Poletiko, C. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Sep 1990. 19p. (In French). Order Number DE91752688. Source: OSTI; NTIS (US Sales Only).

Determination of plutonium 241 in nuclear wastes is important because of long period and high energy of some daughter products. In this report are presented two quantitative analysis methods using both scintillation techniques: A complete method, in any case, by selective extraction of plutonium on an anionic resin allowing simultaneous determination of Pu 241 and the sum of other plutonium isotopes; a simplified method when alpha activity is higher than beta/gamma activity by liquid extraction with TTA. These methods are applied for analysis of 4 waste types: cement encapsulated wastes, bitumen encapsulated wastes, incineration ashes, leaching of encapsulated incineration ashes. In these 4 examples, Pu 241 activity is equal or higher than the sum of alpha plutonium isotope activity. Separation efficiency, measured from Pu 239 or with Pu 236 as tracer, is between 90 and 99%.

13161 (SAND–90-3090C) **An application of selective electrochemical wafer thinning for silicon characterization.** Medernach, J.W.; Stein, H.J.; Stevenson, J.O. Sandia National Labs., Albuquerque, NM (USA). [1990]. 2p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910552–7: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91007517. Source: OSTI; NTIS; GPO Dep.

A new technique is reported for the rapid determination of interstitial oxygen (O_i) in heavily doped n^+ and p^+ silicon. This technique includes application of a selective electrochemical thinning (SET) process and FTIR transmittance measurement on a limited area of a silicon wafer. The O_i is calculated using ASTM F1188–88 with the IOC 88 calibration factor. An advantage of SET over mechanical thinning is that the original wafer thickness and diameter are maintained for additional processing. 1 tab.

13162 (UCRL-JC–106511) **Potentiometric titration of gold, platinum, and some other precious metals.** Selig, W.S. Lawrence Livermore National Lab., CA (USA). 4 Feb 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9103135–1: International Precious Metals Institute sampling and analysis seminar, New Orleans, LA (USA), 10-12 Mar 1991). Order Number DE91008989. Source: OSTI; NTIS; GPO Dep.

Gold, platinum, and several other platinum metals can be determined by titration with cetylpyridinium chloride (CPC). CPC forms a precipitate with $AuCl_4^-$ and $PtCl_6^{2-}$. Differentiation of $AuCl_4^-$ and $PtCl_6^{2-}$ with this titrant is not possible; however, their sum can be determined. Titration with tetraphenylarsonium chloride at pH 1 is selective for tetrachloroaurate, which thus can be determined in the presence of hexachloroplatinate. Hexachlorooosmate(IV), tetrachloroplatinite(II), tetrachloropalladate(II), hexachloropalladate(IV), and hexachloroiridate(IV) can also be determined potentiometrically vs. CPC. The indicating electrode is prepared by coating a spectroscopic graphite rod with a solution of poly(vinyl chloride) (PVC) and dioctylphthalate (DOP) in tetrahydrofuran (THF). Gold in gold cyanide plating baths and in potassium aurocyanide can be determined by potentiometric titration vs standard silver nitrate, using a silver ion-selective indicating electrode. The monovalent gold need not be converted to the trivalent state with aqua regia, resulting in a considerable saving of time and effort. Free cyanide and aurocyanide can be titrated sequentially by this method. Chloride does not interfere and can, in fact, also be sequentially determined. 17 refs., 2 figs., 3 tabs.

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Refer also to citation(s) 12306, 12447, 12915, 12994, 13115, 13124, 13134, 13140, 13144, 13159, 13184, 13186, 13187, 13188, 13432, 13486, 13614

13163 (CONF-900858–, pp. 550-557) **Surface study of absorbents from the removal of SO_2/NO_x from coal combustion gases.** Cooper, B.R. (West Virginia Univ., Morgantown (USA)); Hao, Y.G.; Cao, Y.; Montano, P.A. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings*. 604p. Order Number DE91004208. Source: OSTI; NTIS.

CuO/Al_2O_3 shows considerable promise as regenerable SO_2 and NO_x adsorbents for flue-gas clean up. The major interest in this study is to investigate the Cu local environment in the presence of the flue gases and to seek the best way to reliably simulate the surface adsorption of the system. The chemical environment at the transition metal site can be better studied using X-rays; because of the penetration capabilities of X-rays, in-situ studies become possible. Extended X-ray Absorption Fine Structure (EXAFS) and X-ray Absorption Near Edge Structure (XANES) have been used in recent years to study local structures. The authors report here a series of in-situ EXAFS and XANES measurements on CuO/Al_2O_3 sorbents and model compounds. They investigated the evolution of the structure at the Cu site as a function of temperature in the presence and the absence of flue gases. They also measured the EXAFS and XANES spectra at the sulfur K-edge. The theoretical calculations involve designing and developing computational models based on available experimental information, using the models to find the copper site on the supporting material through accurate total energy calculation, finding possible configuration of SO_2 adsorption on CuO/Al_2O_3 surface through comparing the bonding energy for different adsorption sites, and calculating the electronic structure of the system, through which one can study the mechanism of the adsorption at the atomic level. In the following paragraphs, the authors describe the methodology employed and summarize the results.

13164 (CONF-9105137–1) **Solvation in supercritical water.** Cochran, H.D. (Oak Ridge National Lab., TN (USA)); Cummings, P.T.; Karaborni, S. Oak Ridge National Lab., TN (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400 ;FG05-88ER13943. From 2. international conference on supercritical fluids; Boston, MA (USA); 20-22 May 1991. Order Number DE91009124. Source: OSTI; NTIS; INIS; GPO Dep.

The aim of this work is to determine the solvation structure in supercritical water composed with that in ambient water and in simple supercritical solvents. Molecular dynamics studies have been undertaken of systems that model ionic sodium and chloride, atomic

argon, and molecular methanol in supercritical aqueous solutions using the simple point charge model of Berendsen for water. Because of the strong interactions between water and ions, ionic solutes are strongly attractive in supercritical water, forming large clusters of water molecules around each ion. Methanol is found to be a weakly-attractive solute in supercritical water. The cluster of excess water molecules surrounding a dissolved ion or polar molecule in supercritical aqueous solutions is comparable to the solvent clusters surrounding attractive solutes in simple supercritical fluids. Likewise, the deficit of water molecules surrounding a dissolved argon atom in supercritical aqueous solutions is comparable to that surrounding repulsive solutes in simple supercritical fluids. The number of hydrogen bonds per water molecule in supercritical water was found to be about one third the number in ambient water. The number of hydrogen bonds per water molecule surrounding a central particle in supercritical water was only mildly affected by the identity of the central particle–atom, molecule, or ion. These results should be helpful in developing a qualitative understanding of important processes that occur in supercritical water. 29 refs., 6 figs.

13165 (DOE/ER/13580–1) **Mechanisms and controlling characteristics of the catalytic oxidation of methane: Progress report.** Klier, K.; Simmons, G.W.; Herman, R.G.; Miller, A.C. Lehigh Univ., Bethlehem, PA (USA). Dec 1990. 11p. Sponsored by USDOE,. DOE Contract FG02-86ER13580. Order Number DE91008033. Source: OSTI; NTIS; GPO Dep.

The objective of the proposed research is to develop new ways to control the catalytic and selective oxidation of methane to oxygenates other then CO_2 under mild reaction conditions by using halogen-free surface species that are stable under reaction conditions and that control the size of palladium ensembles available chemisorption of methane and oxygen. This will ensure the absence of Cl-containing products in the product and will result in surface modifiers, e.g. palladium alloy moieties, that are more stable at higher temperatures than are CCl_2- and Cl-produced site blocking agents. The model catalysts being utilized are initially single crystals of planar Pd(100), stepped Pd(311), and stepped and kinked Pd(679), which will also provide for the structure sensitivity of the selective oxidation of CH_4 to be probed. 6 refs., 1 fig.

13166 (DOE/ER/13616–5) **[Free radical and rearrangement reactions in coal liquefactions]: Progress report.** Gajewski, J.J. Indiana Univ., Bloomington, IN (USA). Dept. of Chemistry. [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER13616. Order Number DE91009672. Source: OSTI; NTIS; GPO Dep.

Studies on rearrangement reactions in coal liquefaction have continued. The pyrolysis of 5-methylenespiro [3,5] nonane results in a retro 2+2 cleavage and a 1,3-shift to $\Delta^{1,2}$- octalin in a 1:2 ratio, respectively. This is in contrast to a 2:1 ratio usually observed for conformationally unbiased vinylcyclobutanes. 5-Methylenespiro [3,5] nona-1-ene was prepared, and its thermal rearrangement to $\Delta^{1-2,3}$-hexalin was examined. Also formed is a triene resulting from cyclobutene ring opening. Work continues on developing a force-field appropriate to organometallic systems. The model is extremely simple. It assumes that all metal ligand bond distances are a function of a ligand and the covalent radius of the metal. The model ignores bond angle and torsion potentials at the metal so that steric size and electrostatics determine geometry.

13167 (DOE/ER/13626–4) **Morphological aspects of surface reactions: Progress report, September 1989–September 1990.** White, J.M. Texas Univ., Austin, TX (USA). Dept. of Chemistry. Oct 1990. 6p. Sponsored by USDOE,. DOE Contract FG05-86ER13626. Order Number DE91008284. Source: OSTI; NTIS; GPO Dep.

The ability of carbon monoxide to oxidatively disrupt, and disperse, Rh particles on TiO_2 has been demonstrated at temperatures as low as 160 K. At temperatures above 473 K, CO reduces oxidized Rh. The ability of a low work function material, potassium, to activate CO_2 by donating electron density to form CO_2^- has been demonstrated on Pt(111). Dissociation of carbon dioxide and the formation of the anionic species have been experimentally verified. The interaction of low energy electrons (<50 EV) with benzene adsorbed on Ag leads to the formation of adsorbed phenyl fragments in the absence of other species. These nonthermal activation methods have great potential for the clean synthesis of catalytically interesting intermediates for study using the tools of surface chemical science. The photochemistry of several small alkyl halides on Ag(111) at 100 K has been examined. In every case, the carbon-halogen bond is cleanly broken leaving a large fraction of the alkyl fragments, and all of the halogens, adsorbed. In subsequent TPD, the alkyl fragments simply recombine to form hydrocarbons which desorb promptly.

13168 (DOE/ER/13744–11) **Theory of the dissociation dynamics of small molecules on metal surfaces: Finite temperature studies: Annual progress report, July 1, 1990–June 30, 1991.** Jackson, B.E. Massachusetts Univ., Amherst, MA (USA). Dept. of Chemistry. Feb 1991. 7p. Sponsored by USDOE,. DOE Contract FG02-87ER13744. Order Number DE91008512. Source: OSTI; NTIS; GPO Dep.

Studies of the dissociative adsorption of diatomics on metals can tell us much about metal catalyzed reactions. Proper theoretical treatments have been hindered by the difficulty of including all important degrees of freedom quantum mechanically. In earlier studies we developed efficient time dependent methods for surmounting these problems. During this past year models were implemented in which molecular vibration, rotation and translation normal to the surface were treated quantum mechanically. Probabilities for dissociative sticking and rotational excitation were computed as a function of the kinetic and internal energy of the molecule, as well as the surface impact site. Comparisons were made with earlier studies of lower dimensionality. The remaining degrees of freedom are now being included classically in a comparison with experimental studies of H_2, N_2 and O_2. Techniques which were developed for coupling the gas particle to thermal vibrations of the solid were used to study trapping. Sticking probabilities were computed for He, Ne and Ar over a wide range of temperatures, kinetic energies, impact angles and gas-surface potentials. These techniques are now being used to examine the trapping of H_2 and other diatomics in the weak precursors often found in dissociative adsorption pathways. 7 refs.

13169 (DOE/ER/13876–1) **Photochemistry of metalloporphyrins: Progress report, August 1, 1987–August 31, 1990.** Spiro, T.G. Princeton Univ., NJ (USA). Dept. of Chemistry. [1990]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER13876. Order Number DE91009136. Source: OSTI; NTIS; GPO Dep.

During the current period our efforts have been focussed on the characterization of porphyrin radical cations, anions, and excited states, and of oxo-metal prophyrins, using resonance Raman (RR) spectroscopy. RR spectra of octaethyl porphyrin and tetraphenylporphyrin radical cations showed different frequency shift patterns, which were interpreted in terms of the expected behavior of a_{1u} and a_{2u} radicals. Anomalously polarized RR bands were discovered whose frequencies and isotope shifts differed greatly from those of the neutral parents, and which signalled pseudo-Jahn-Teller activity in A_{2g} modes which mix the A_{1u} and A_{2u} ground and low-lying excited states. The RR spectrum of the ZnTPP radical anion showed modest frequency downshifts in Jahn-Teller (J-T) active B_{1g} and B_{2g} modes, but no significant polarized scattering from these modes, indicating that the J-T effect is dynamic in character. Manganyl porphyrins were found to have anomalously low metal-oxo stretching frequencies, and the weakness of the bond was related to electronic properties of the d^3 Mn(IV) ion and its interactions with the porphyrin orbitals. Vanadyl porphyrins were used to assess the influence of solvents and axial ligands and of the effects of porphyrin radical cation formation on the metal-oxo bond. 13 refs.

13170 (DOE/ER/60648–3) **Studies of the formation, chemical reactivity, and properties of small clusters: Application to an understanding of aerosol formation and heterogeneous chemistry: Annual technical progress report, March 1989–March 1990.** Castleman, A.W. Jr. Pennsylvania State Univ., University Park, PA (USA). Dept. of Chemistry. [1990]. 66p. Sponsored by USDOE,. DOE Contract FG02-88ER60648. Order Number DE91007876. Source: OSTI; NTIS; INIS; GPO Dep.

The small cluster program involves (1) studies of reactions related to formation and growth of heteromolecular clusters and their

thermochemical properties, (2) studies of photoinitiated processes in clusters, (3) investigations related to heterogeneous reactions including the influence of reaction centers on the interconversion, and (4) theoretical calculations of properties, dynamics, and structure. A major thrust of the work during the past year has been devoted to a study of the role of ionization and the presence of ions on reactions and energetics. During the past few months, particular attention has been paid to systems having varying proton affinities. From the data, we can determine the influence of these values on the nature of the reactions and ascertain the ultimate chemical nature of the ionization center formed as a result of the reactions. 83 refs., 12 figs., 2 tabs.

13171 (ETDE-mf–1756508) **Development and testing of zeolite-catalysts for the improvement of the SCR-technology.** Schroeder, K.J.; Schroeder, P.; Grimm, B.; Deutz, W. IBS Engineering und Consulting Ingenieur-Buero Schroeder GmbH, Hoehr-Grezhausen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Aug 1990 52p. (In German). Contract BMFT 01 VQ 8704/1;BMFT 01 VQ 8803. Order Number DE91756508. Source: OSTI; NTIS (US Sales Only).

The properties of the catalysts determine the efficiency of the SCR-technology. The advantages of the developed zeolite-catalysts are: - high activity in a broad temperatur-range (150-450deg C), - sequential ammonia oxidation, - high resistivity against poisining (results of aging are better compared to TiO_2-catalysts), - high activity and the additional ammonia oxidation reduce the catalyst volume, - production costs of the zeolite catalyst are lower compared to catalyst based on TiO_2. Running this R+D work, IBS has investigated the parameters of the zeolite raw materials, the binder-systems and the technology of ceramical production of honeycombs and the feasibility for SCR. The production methods were improved. Scale-up work was done. Poisoning resistivity was approved in longterm tests. (orig.).

13172 (FRNC-TH–3698) **Thermodynamic and electrochemical properties of some rare earth cryptates and related complexes in propylene carbonate.** Loufouilou, E.L. Strasbourg-1 Univ., 67 (France). Mar 1986. 207p. (In French). Order Number DE91752682. Source: OSTI; NTIS (US Sales Only).

The stability of trivalent lanthanide complexes with [1]-cryptand 22 and [2]-cryptands 222 and 211 and also tris (3.6- dioxa heptyl) amine (TDHA) is studied in propylene carbonate solution by potentiometry with Ag^+ as an auxiliary cation. Complexation enthalpies and entropies are determined for other complexes of some trivalent lanthanides (La, Er, Pr and Eu) with ligands 222, 221, 211, 22, 21, 18C6 and TDHA. [1]- and [2]- crytands are complexing agents more powerful than TDHA and crown-ethers 15C6 and 18C6. For ligands containing nitrogen complexe stability increase with RE atomic number but decrease for crown-ethers. In propylene carbonate complexes are stabilized by enthalpic effects, entropic contribution is variable. Polarographic reduction of samarium cryptate with ligand 222, 221 and 22 in propylene carbonate is reversible as in more solvating solvents water and methanol. Mixed complexes are formed with chlorides and this cryptate system is more difficult to reduce.

13173 (IS-T–1493) **Mechanistic studies on reactivities of organometallic macrocyclic complexes of chromium and cobalt.** Shi, Shu. Ames Lab., IA (USA). 10 Dec 1990. 171p. Sponsored by USDOE,. DOE Contract W-7405-ENG-82. Order Number DE91007525. Source: OSTI; NTIS; INIS; GPO Dep.

Reaction pathways leading to the formation and cleavage of a transition metal-carbon bond at various oxidation states of the metal occupy a central position in understanding many enzymatic reactions and designing catalysts. The report is divided into six parts that (1) focus on the homolysis vs heterolysis of a C-Cr(III) bond, (2) describes a unique chain reaction and a S_E2 reaction I_2 and $RCrL^{2+}$, (3) concerns the oxidation of organochromium(III) complexes by dihalide and pseudo-dihalide radical anions generated by pulse radiolysis, (4) concentrates on the oxidation mechanism of $RCr(H_2O)^{2+}$ and the fate of $RCr(H_2O)^{3+}$ as well as the corresponding reduction potentials, (5) extends study of organocobalt complexes with attention to reduction induced cleavages of a transition metal-carbon bond, and (6) describes the crystallization of $[(CH_3)_4N][Co(dmgBF_2)_2py]$ and reports its molecular structure as determined by x-ray diffraction. 182 refs., 25 figs., 16 tabs. (BM)

13174 (IS-T–1498) **Photoion-photoelectron coincidence studies clusters and transient molecules.** Norwood, K. Ames Lab., IA (USA). 16 Nov 1990. 197p. Sponsored by USDOE,. DOE Contract W-7405-ENG-82. Order Number DE91006695. Source: OSTI; NTIS; GPO Dep.

Experimental photoion-photoelectron coincidence (PIPECO) spectra have been obtained at different nozzle stagnation pressures for Ar, Kr, Xe, and CO dimers and trimers in the wavelength regions corresponding to the respective ground states through all states accessible with a photon energy of 20 eV. Ionization energies for all ground states were measured and agree well with previously reported values. The formation of stable dimer ions from fragmentation of larger cluster ions initially produced by photoionization is efficient. For nozzle expansion conditions which minimize the formation of clusters larger than dimers, the intensities of the excited PIPECO bands for all clusters, except Ar_2^+ and Ar_3^+, are found to be negligible with respect to the ground state PIPECO bands. The PIPECO technique has been used successfully to obtain the mass-selected threshold photoelectron spectra of the SO and S_2O transient molecules formed from a microwave discharge, effusive beam source. Analysis of the PIPECO spectra of all the clusters and transient molecules are presented. 177 refs., 32 figs., 6 tabs.

13175 (IS-T–1508) **Gas-phase generations and rearrangement of silathiones, $R_2Si{=}S$.** Kim, Chong Bok. Ames Lab., IA (USA). 8 Jan 1991. 102p. Sponsored by USDOE,. DOE Contract W-7405-ENG-82. Order Number DE91007524. Source: OSTI; NTIS; GPO Dep.

Three routes are explored for the generation of silathiones: (1) the retroene elimination of propene from allylthiodimethylsilane and 1-allythio-1-hydrido-1,2,2,2-tetramethylsilane; (2) the reaction of silylene, Me_2Di, with carbon disulfide which is thought to form a transient 3-membered ring with CS_2 and the elimination of carbon disulfide to produce diethylsilathione; and (3) the beta-elimination of bis(trimethylsilythio)dimethylsilane. All these methods are explored in some detail. A second example of a silathione-silylene isomerization was observed in the pyrolysis of 1,1-bis(trimethylsilythio)-1,2,2,2-tetramethyldisilane. 89 refs., 5 figs., 10 tab. (BM)

13176 (LA-UR–91-409) **High efficiency resonance ionization mass spectrometric analysis by external laser cavity enhancement techniques.** Johnson, S.G.; Rios, E.L.; Miller, C.M.; Fearey, B.L. Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910123–5: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA). 20-25 Jan 1991). Order Number DE91007494. Source: OSTI; NTIS; INIS; GPO Dep.

The demand to measure high dynamic range isotope ratios on small samples with resonance ionization mass spectrometry (RIMS) continues to increase. This paper discusses high ionization efficiency methods which can be applied to continuous wave (cw) RIMS to potentially achieve several tens of percent ionization efficiencies for certain elements. The primary technique under development to achieve this is an external laser cavity which can generate very high circulating laser powers. 12 refs., 3 figs.

13177 (LBL–29875) **The surface chemistry of Si(111) (7 x 7): Reactions with Co and with small organic molecules.** Kollrack, M.M. Lawrence Berkeley Lab., CA (USA). Nov 1990. 165p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009741. Source: OSTI; NTIS; GPO Dep.

The reactions of Si(111) (7 x 7) surfaces with Co, benzene, and various alkyliodides were studied to gain insights into the surface chemistry of this important semiconductor. The reactions of Co with Si(111) produced epitaxial $CoSi_2$(111) films, a promising metallization material for Si semiconductor devices. The adsorption of benzene on $CoSi_2$(111) was used to characterize this surface and compare its surface chemistry to that of Si(111). The thermal decompositions of alkyliodides on Si(111) were studied to investigate

the desorption mechanisms of alkyl groups. The intact desorption of alkyl groups is of critical importance in organometallic vapor deposition processes. 49 figs., 78 refs.

13178 (LBL–29883) **Nonlinear optical spectroscopy of Ce^{3+} ions in insulating crystals.** Piehler, D. Lawrence Berkeley Lab., CA (USA). Nov 1990. 161p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91008928. Source: OSTI; NTIS; GPO Dep.

The experiments described are: electronic coherent anti-stokes Raman spectroscopy. CARS is a form of four-waving mixing in which two input lasers at frequencies ω_1 and ω_2 interact within a nonlinear medium to produce a third coherent beam at frequency $\omega_3 = 2\omega_1 - \omega_2$. Resonances are observed in the signal at ω_3 as $(\omega_1 - \omega_2)$ is swept through the electronic energy levels of the Ce^{3+} ion. 4f → 5d two-photon absorption. The simplest and most direct way to investigate the nature of the 5d configuration in Ce^{3+}:$LuPO_4$ is by two-photon absorption. Although two-photon transients between the 4f and 5d configurations are formally parity forbidden they are allowed in second order by the odd parity components of the crystal field. Simulated electronic Raman scattering. One of the original motivations for this work was to determine if electronic Raman processes in rare earth crystals could be strong enough for the observation of stimulated electronic Raman scattering. Stimulated electronic Raman scattering has been observed in atomic vapors, but not never involving ions in crystals. No stimulated electronic Raman processes were observed in CeF_3. 117 refs., 45 figs., 7 tabs.

13179 (PNL–7624) **Molecular Science Research Center annual report.** Knotek, M.L. Pacific Northwest Lab., Richland, WA (USA). Jan 1991. 122p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008429. Source: OSTI; NTIS; GPO Dep.

The Chemical Structure and Dynamics group is studying chemical kinetics and reactions dynamics of terrestrial and atmospheric processes as well as the chemistry of complex waste forms and waste storage media. Staff are using new laser systems and surface-mapping techniques in combination with molecular clusters that mimic adsorbate/surface interactions. The Macromolecular Structure and Dynamics group is determining biomolecular structure/function relationships for processes the control the biological transformation of contaminants and the health effects of toxic substances. The Materials and Interfaces program is generating information needed to design and synthesize advanced materials for the analysis and separation of mixed chemical waste, the long-term storage of concentrated hazardous materials, and the development of chemical sensors for environmental monitoring of various organic and inorganic species. The Theory, Modeling, and Simulation group is developing detailed molecular-level descriptions of the chemical, physical, and biological processes in natural and contaminated systems. Researchers are using the full spectrum of computational techniques. The Computer and Information Sciences group is developing new approaches to handle vast amounts of data and to perform calculations for complex natural systems. The EMSL will contain a high-performance computing facility, ancillary computing laboratories, and high-speed data acquisition systems for all major research instruments.

13180 (PSI–88) **The adsorption of Cs^+, Sr^{2+} and Ni^{2+} on bitumen: a mechanistic model.** Loon, L.R. Van (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Kopajtic, Z. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1991. 55p. Order Number DE91623216. Source: OSTI: NTIS (US Sales Only); INIS.

The adsorption of radionuclides on the waste matrix is a positive effect and contributes to the retardation of released radionuclides migrating to the geo-and biosphere. For the safety assessment studies, it is important to know whether or not radionuclides do adsorb on the waste matrix. In the present work the adsorption of $^{134}Cs^+$, $^{85}Sr^{2+}$ and $^{63}Ni^{2+}$ on bitumen was studied as a function of the pH and ionic strength of the equilibrium solution. Bitumen emulsions with well defined surfaces were used. The surface of bitumen is negatively charged due to the deprotonation of weak acid carboxyl groups at the interface. The functional group density amounts to $1.37.10^{16}$ groups/m^2 and their deprotonation behaviour can be well described by the 'Ionizable Surface Group' model. Cs^+, Sr^{2+} and Ni^{2+} adsorb on the surface by three different processes, i.e. ion exchange, outer sphere complexation and inner sphere surface complexation respectively. The adsorption depends on the pH and the ionic strength of the contact solution. Under near field conditions, Cs^+ and Sr^{2+} do not adsorb on the bitumen due to the competition with Na^+, K^+ and Ca^{2+} present in the cement pore water in contact with the bitumen. Ni^{2+} adsorption can also be neglected because the formation of neutral and anionic hydroxo complexes in solution competes strongly with the adsorption reaction. Other hydrolysable radionuclides of interest are expected to behave similarly to Ni^{2+}. The main conclusion of the study is that the adsorption of radionuclides under near field conditions is expected to be very low. Consequently, this process need not to be considered in safety assessment studies. (author) figs., tabs., 30 refs.

4004 Electrochemistry

Refer also to citation(s) 12876, 12925, 13031, 13062, 13528, 13846

13181 (LBL–29845) **The effect of suspended particles on the rate of mass transfer to a rotating cylinder electrode.** Gibbons, D.W.; Tobias, C.W.; Muller, R.H. Lawrence Berkeley Lab., CA (USA). Dec 1990. 128p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009315. Source: OSTI; NTIS; GPO Dep.

Thesis. Submitted by D.W. Gibbons.

Mass transfer enhancement produced by the addition of inert microspheres was investigated on a rotating, cylindrical electrode (RCE). The effects of rotation speed, rotor radius, particle size, solids volume fraction, and article density on the rate of mass transfer in the turbulent flow field created by rotating the inner cylinder were determined by limiting current measurements for ferricyanide ion reduction. The suspensions contained polymeric or ceramic spheres of various sizes (5-80 μm), densities, and volume fractions (0-.40). Experiments were conducted with inner cylinders of three different diameters at rotation speeds ranging from 250 to 4000 rpm. An optimal choice of particle radius (a), density, and volume fraction (Φ) produced limiting current densities nearly three times larger than those obtained without solids. With or without neutrally buoyant particles present, the mass transport rate displayed essentially the same power dependence on electrode rotation speed. In contrast, the transport enhancement (relative to Φ = O) achieved with microspheres more dense than the electrolyte decreased dramatically at high rotation speeds, most likely because of particle movement away from the electrode surface in the centrifugal force field created by the spinning cylinder. In the size range studied, the limiting current was found to be only a weak function of particle radius.

4005 Photochemistry

Refer also to citation(s) 13095, 13119, 13121, 13169, 13170, 13174, 13183, 13184, 13527

13182 (BNL–52265) **Proceedings of the Fourteenth DOE solar photochemistry research conference.** Brookhaven National Lab., Upton, NY (USA). [1989]. 238p. Sponsored by USDOE,. DOE Contract AC02-76CH00016. (CONF-8906383–Summ.: 14. DOE solar photochemistry research conference, Lake Harmony, PA (USA), 3-7 Jun 1989). Order Number DE91006617. Source: OSTI; NTIS; GPO Dep.

The central themes of this year's Solar Photochemistry Research Conference encompassed initial charge separation in photosynthesis, photoinduced charge separation in other organized assemblies, electron transfer, organic and inorganic photochemistry, and photoelectrochemistry. This volume contains a copy of the program the abstracts of 29 formal presentations and 47 posters. a record of the discussion following each presentation, and an address list for the 96 attendees. Individual projects are processed separately for the databases.

4006 Radiation Chemistry

Refer also to citation(s) 13173, 13327, 13430, 13562

13183 (ANL/RPG–91/1) **Radiation and photochemistry section: Annual report, October 1989–September 1990.** Argonne National Lab., IL (USA). Jan 1991. 57p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. Order Number DE91007665. Source: OSTI; NTIS; INIS; GPO Dep.

The highlights of this past year in the Radiation and Photochemistry Section at Argonne include: (1) picosecond optical studies of radical cations and excited states produced in hydrocarbon radiolysis provided the first kinetic measurements of ion transformation and production of triplet and singlet excited states by ion recombination. (2) studies of radical cations of alkyl-substituted amines and sulfides provided insights into ion-molecule reactions of radical cations in the condensed phase. (3) studies of the behavior of strained alkane radical cations, such as cubane $^{+\cdot}$, revealed new rearrangements and remarkable, medium-dependent differences in their structures. (4) H·atom reactions yielding e_{aq}^- provided the first reliable measurements of hydrated-electron enthalpy and entropy and forced the revision of some previous thinking about the driving force in $_{aq}^-$ reactions.

13184 (DOE/ER/00038–3345) **Radiation Laboratory, University of Notre Dame quarterly report, October 1–December 31, 1990.** Notre Dame Univ., IN (USA). Radiation Lab. 23 Jan 1991. 40p. Sponsored by USDOE,. DOE Contract AC02-76ER00038. (NDRL–3345). Order Number DE91007969. Source: OSTI; NTIS; GPO Dep.

This report, on research preformed at the Radiation Laboratory, University of Notre Dame, contain contributions on such topics as: formation of carbenium ions or yields from carbenes, photochemical oxidations and reductions, photoreactivity of molybdates, radiolysis of water, spin trapping kinetics, pulse radiolysis, photogenerated radical anions, photochemistry of Fe and Re complexes, hyperfine coupling calculations, electron energy loss in hydrocarbons, radiolysis of halophenols, conductivity in lipid monolayers, solitonsin polyacetylene, triplet-triplet annhilation, random walk problems, proton and electron impact on water luminescence quenching, raman spectrum of ozonide ion, time-resolved spectra of supercritical fluids, sequential biphotonic photochemistry, reduction of CO_2 with Cu(I) macrocycles,and studies on photosensitizing dyes and on air-water interface problems. (CBS)

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 12442, 12445, 13327, 13543

13185 (CEA-R–5535) **Chemistry of neptunium and of other actinides in carbonate medium.** Riglet, C. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Paris-6 Univ., 75 (France). 1990. 272p. (In French). Order Number DE91752669. Source: OSTI; NTIS (US Sales Only).

This work is a contribution to the establishment of a thermodynamic data base in order to forecast the behaviour of Np and other actinides in natural waters that might come into contact with a nuclear waste repository. Redox potentials and complexation constants in acidic and carbonate media are measured in aqueous solutions, in the presence of an inert salt (sodium perchlorate) of variable concentrations. The activity coefficients are calculated, from the variation of thermodynamic measurements with the ionic strength, with the Specific Interaction Theory (S.I.T.). The electrochemical data, obtained by polarography and voltamperometry, are interpreted, for irreversible systems, with numerical and graphical methods based on the Koutecky-Weber's and S.I.T. equations. The equilibrium constants in carbonate medium are measured by absorption spectrophotometry and a graphical method is proposed to determine the stoichiometries of polynuclear species. In this work are proposed numerical data relative to: - the redox potentials of the systems: M(VI/V) and M(IV/III) in acidic medium where M = U, Np, Pu; U(VI/V) in carbonate medium; Np(VI/V) in bicarbonate medium of ionic strength 3 M. - the formation constants of the hexakis (carbonato) tris [dioxoneptunate (VI)] complex in 3 M medium - the formation constants of the mono, di and tri (carbonato) dioxoneptunate (V) complexes - the influence of the ionic strength on some of the studied chemical equilibria by using, when necessary, literature results. All specific interaction coefficients (activity coefficients) of these species are also measured or calculated.

13186 (COO–1713-160) **Reaction studies of hot silicon, germanium and carbon atoms: Progress report, September 1, 1987–January 31, 1989.** Gaspar, P.P. Washington Univ., St. Louis, MO (USA). Dept. of Chemistry. 1 Feb 1989. 6p. Sponsored by USDOE,. DOE Contract AC02-76ER01713. Order Number DE91008170. Source: OSTI; NTIS; GPO Dep.

Research has been continued on hot silicon, germanium and carbon atoms. The results of experiments directed toward attaining the goals of this research program are briefly presented for the period September 1, 1987 to January 31, 1989 in sections entitled: (1) The mechanism of hydrogen acquisition by high energy silicon atoms. (2) The mechanism of disilene formation in the reactions of recoiling silicon atoms with silane. (3) The contribution of ionic processes to the primary reactions of recoiling silicon atoms. (4) The role of phosphine in hydrogen acquisition by recoiling silicon atoms. (5) Mechanism of reaction of recoiling carbon atoms with aromatic molecules.

13187 (DOE/ER/01713–141) **Reaction studies of hot silicon, germanium and carbon atoms: Progress report, August 1, 1984–November 15, 1985.** Gaspar, P.P. Washington Univ., St. Louis, MO (USA). Dept. of Chemistry. 15 Nov 1984. 9p. Sponsored by USDOE,. DOE Contract AC02-76ER01713. Order Number DE91008145. Source: OSTI; NTIS; GPO Dep.

Research has been continued on hot silicon, germanium and carbon atoms. Progress in the period August 1, 1984 to November 15, 1985 is reviewed in the following areas: (1) Recoil atom reaction studies. (2) Reactions of thermally generated free atoms. (3) Reactions of chemically generated silylenes.

13188 (DOE/ER/01713–145) **Reaction studies of hot silicon, germanium and carbon atoms: Progress report, November 16, 1985–November 15, 1986.** Gaspar, P.P. Washington Univ., St. Louis, MO (USA). Dept. of Chemistry. 15 Nov 1986. 5p. Sponsored by USDOE,. DOE Contract AC02-76ER01713. Order Number DE91008169. Source: OSTI; NTIS; GPO Dep.

Research has been continued on hot silicon, germanium and carbon atoms. Progress in the period November 16, 1985 to November 15, 1986 is reviewed in the following areas: (1) Recoil atom reaction studies. (2) Reactions of thermally generated free atoms.

13189 (DOE/ER/01713–170) **Reaction studies of hot silicon, germanium and carbon atoms: Final report.** Gaspar, P.P. Washington Univ., St. Louis, MO (USA). Dept. of Chemistry. 1 Nov 1990. 23p. Sponsored by USDOE,. DOE Contract AC02-76ER01713. Order Number DE91006921. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of this project was to increase the authors understanding of the interplay between the kinetic and electronic energy of free atoms and their chemical reactivity by answering the following questions: (1) what is the chemistry of high-energy carbon silicon and germanium atoms recoiling from nuclear transformations; (2) how do the reactions of recoiling carbon, silicon and germanium atoms take place - what are the operative reaction mechanisms; (3) how does the reactivity of free carbon, silicon and germanium atoms vary with energy and electronic state, and what are the differences in the chemistry of these three isoelectronic atoms? This research program consisted of a coordinated set of experiments capable of achieving these goals by defining the structures, the kinetic and internal energy, and the charge states of the intermediates formed in the gas-phase reactions of recoiling silicon and germanium atoms with silane, germane, and unsaturated organic molecules, and of recoiling carbon atoms with aromatic molecules. The reactions of high energy silicon, germanium, and carbon atoms created by nuclear recoil were studied with substrates chosen so that their products illuminated the mechanism of the recoil reactions. Information about the energy and electronic state of the recoiling atoms at reaction was obtained from the variation in end product yields and the extent of decomposition and rearrangement of primary products (usually reactive intermediates) as a function of total pressure and the concentration of inert moderator molecules that remove kinetic energy from the recoiling atoms and can induce transitions between electronic spin states. 29 refs.

13190 (IAERU–9002) **Proceedings of IAERU seminar-VI, 'reactor chemistry'.** Rikkyo Univ., Yokosuka, Kanagawa (Japan). Inst. for Atomic Energy. Nov 1990. 122p. (In Japanese). (CONF-9006327–: 6. IAERU seminar, 'reactor chemistry', Tokyo (Japan), 9 Jun 1990). Order Number DE91755687. Source: OSTI; NTIS (US Sales Only): INIS.

This issue is the collection of the papers presented at the title meeting. Four of the presented papers are indexed individually. (J.P.N.).

13191 (LA-UR–91-147) **Pulsed photothermal spectroscopy applied to lanthanide and actinide speciation.** Berg, J.M. (Los Alamos National Lab., NM (USA)); Morris, D.E.; Clark, D.L.; Tait, C.D.; Woodruff, W.H.; Ven Der Sluys, W.G. Los Alamos National Lab., NM (USA). [1991]. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910123–1: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91007391. Source: OSTI; NTIS; INIS; GPO Dep.

Several key elements important for the application of laser-based photothermal spectroscopies to the study of the complexation chemistry of lanthanides and actinides in solution have been demonstrated. The sensitivity of f-f electronic transition energies and band intensities to subtle changes in complexation was illustrated through comparison of visible and near infra-red absorption spectra of well-characterized U(IV) dimers with alkoxide ligands. Significant improvements in spectroscopic band resolution and energy measurement precision for solution species were shown to be achievable through work in frozen glasses at 77 K using a very simple cryogenic apparatus. A pulsed-laser photothermal spectroscopy apparatus was constructed and shown to be sensitive to optical density changes of 10^{-5} in an aqueous Nd^{3+} solution. In addition, the capability of obtaining photothermal lensing spectra of dilute actinide solutions in frozen glasses at 77 K was demonstrated. 6 refs., 5 figs.

13192 (LBL–29815) **Chemistry of the transactinide elements.** Hoffman, D.C. Lawrence Berkeley Lab., CA (USA). Oct 1990. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9010297–3: 34. Robert A. Welch Foundation conference on chemical research: fifty years with transuranium elements, Houston, TX (USA), 22-23 Oct 1990). Order Number DE91009738. Source: OSTI; NTIS; GPO Dep.

The investigation of the chemical properties of the transactinide elements is particularly exciting because of the possibility that relativistic effects may alter the relative stability of the 7s, 6d, 7p valence electrons to such an extent that other oxidation states than those expected from simple extrapolation may be stabilized and the ionic radii may even be affected. In a recent review of relativistic effects in structural chemistry, Pyykkoe has stated that for the 6s of Au or the 6p electrons of Tl the relativistic change of the atomic potential is less important than the direct dynamical effect on the valence electrons. Further, the p, d, and f electrons (which never come close to the nucleus) will be affected due to more efficient screening from the nuclear charge because of the relativistic contraction of the s and p orbitals. Thus, these orbitals will increase in energy and extend outward radially. In summary, the primary relativistic effects on the atomic orbitals are: (1) contraction of the radius and energetic stabilization of s and p shells; (2) spin-orbit splitting of the $l>0$ orbitals; (3) increased radii and energetic destabilization of the outer d and all f orbitals. All of these effects are believed by Pyykkoe to be of the same order of magnitude and will increase approximately as Z_2. The comparison of such fundamental chemical properties as the most stable oxidation states and complex formation with those of lighter homologs are invaluable in evaluating the magnitude of the relativistic effects. 56 refs., 10 figs.

13193 (SAND–90-2250C) **Application of a chemical ion exchange model to transport cask surface decontamination.** Chambers, W.B.; Doughty, D.H.; Jones, H.D.T.; Martinez, S.H.; Bennett, P.C. Sandia National Labs., Albuquerque, NM (USA). [1991]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910577–2: 2. international conference on transportation for the nuclear industry, Bournemouth (UK), 8-10 May 1991; TTC–0717). Order Number DE91007069. Source: OSTI; NTIS; INIS; GPO Dep.

Radionuclide contamination of stainless steel surfaces occur during submersion in a spent fuel storage pool. Subsequent release or desorption of these contaminants from a nuclear fuel transportation cask surface under varying environmental conditions occasionally results in the phenomenon known as contamination "weeping." Experiments have been conducted to determine the applicability of a chemical ion-exchange model to characterize the problem of cask contamination and release. Surface charge characteristics of Cr_2O_3 and stainless steel (304) powders have been measured to determine the potential for ion exchange at metal oxide – aqueous interfaces. The solubility of Co and Cs electrolytes at varying pH and the absorption characteristics of these ions on Cr_2O_3 and stainless steel powders in aqueous slurries have been studied. Experiments show that Co ions do reversibly adsorb on these powder surfaces and, more specifically, that adsorption occurs in the nominal pH range (pH = 4–6) of a boric acid-moderated spent fuel pool. Desorption has been demonstrated to occur at pH $\leq$ 3. Cs ions also have been shown to have an affinity for these surfaces although the reversibility of Cs^+ bonding by H^+ ion exchange has not been fully demonstrated. These results have significant implications for effective decontamination and coating processes used on nuclear fuel transportation casks. 8 refs., 5 figs.

13194 (UCRL-LR–104538) **Report of a workshop on transactinium science.** Hulet, E.K. Lawrence Livermore National Lab., CA (USA). 1 Sep 1990. 127p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008119. Source: OSTI; NTIS; GPO Dep.

A tradition of research in the heaviest elements has long existed at institutions in Northern California, notably the University of California, Berkeley; Lawrence Berkeley Laboratory (and its many predecessor organizations); and Lawrence Livermore National Laboratory. This area of science and technology is of high technical interest, not only because of the unusual chemical,physical, and nuclear properties of these elements, but also because of their importance in matters concerned with national security and national energy policy. From the beginning it was clear that the wider community of heavy-element specialists must be involved in evaluating the status of the field. It was decided on rather short notice to hold a workshop for such a group at the Claremont Hotel in Oakland, California, on June 6–8, 1990, and the community responded affirmatively. Nine panels were thus organized; their chairs and rapporteurs were listed in the Appendix. The charge to each panel was to assess the state of the art in its specialized area, identify important and major issues, and suggest prospects for future research. The proposed Institute would base its initial agenda on the recommendations of the panels. The reports of the nine panels constitute the substance of these proceedings.

13195 (Windscale-Trans–1184) **Process and associated equipment for decontaminating, cleaning all surfaces which are covered with transferrable contamination of a nuclear nature, without creating other wastes.** Tiesse, J.-C.G.; Chauvet, S.; Chabert, R.E.; Dezu, M.D. AEA Technology, Windscale (UK). 1989. 9p. Translation of FR patent document 2264644/B/. Order Number DE91623343. Source: OSTI; NTIS (US Sales Only); INIS.

Translation of FR patent document 2264644/B/.

The invention relates to a process for removing all transferrable contamination of a nuclear nature without creating new nuclear contamination wastes. This process is characterised by the following three stages: spraying and covering the contaminated surfaces with dry ice, without causing any blast; spraying a jet of steam or hot air on to the coated surfaces from very close range; forced ventilation causing total evaporation of the dry ice, bringing about the phenomenon of sublimation. The device for applying the process comprises a dry ice emitter and a spray nozzle for water vapour at a temperature in excess of 70°C. (author).

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Refer also to citation(s) 13089, 13145

13196 (DOE/ER/13439–6) **Infrared absorption spectroscopy and chemical kinetics of free radicals: Progress report, 1**

March 1988–1 February 1991. Curl, R.F.; Glass, G.P. Rice Univ., Houston, TX (USA). [1991]. 14p. Sponsored by USDOE,. DOE Contract FG05-85ER13439. Order Number DE91008282. Source: OSTI; NTIS; INIS; GPO Dep.

A new channel producing ketenyl radical (HCCO) was discovered in the flash photolysis of ketene at 193 nm. $H_2CCO + h\nu(193\ nm) \rightarrow H + HCCO$ by observation near 2020 cm^{-1} of the infrared fundamental of ketenyl corresponding to the antisymmetric motion of the heavy atoms. This band has been partially rotationally analyzed and the rate constant for the reaction of ketenyl with NO has been determined. The OH stretching fundamental of hydroxymethyl radical (CH_2OH) has been observed near 3600 cm^{-1} producing the radical either by the excimer flash photolysis of acetol (CH_3COCH_2OH) or by Cl atom abstraction of a methyl hydrogen from methanol. The assignment of the spectrum to CH_2OH was confirmed by the agreement of the rate constant for the reaction of the species with O_2 with the literature value. The mechanism of the reaction of C_2H with O_2 has been explored. There appear to be two channels producing CO product: a fast, direct one producing highly vibrationally excited CO up to v = 6 at the same rate C_2H disappears and a slow, indirect one producing primarily ground state CO on a much longer timescale than the disappearance of C_2H. The rate constants for the reactions of C_2H with CH_4, C_2H_6, C_2H_4, D_2, and CO were determined by following the time decay of a C_2H infrared transient absorption line originating from the ground vibronic state using diode laser spectroscopy creating the C_2H by excimer laser flash photolysis (ArF, 193 nm) of CF_3CCH. The branching ratio into OH of the reaction between NH_2, and NO, which is the channel thought to propagate the radical chain of the Thermal deNOx process, has been measured up to 925°C. The OH yield thus obtained appears to be too small to maintain the process. 5 refs., 3 figs.

13197 (DOE/ER/13966–2) **Computational and experimental study of laminar flames: Progress report, September 1, 1989–October 31, 1990.** Smooke, M.D. Yale Univ., New Haven, CT (USA). [1990]. 4p. Sponsored by USDOE,. DOE Contract FG02-88ER13966. Order Number DE91008548. Source: OSTI; NTIS; GPO Dep.

We have begun a computational study of nonpremixed tubular methane-air flames with detailed transport and finite rate chemistry. Our multidimensional computation research has been focused primarily on determining the structure of methane-air flames with C_2 chemistry. Experimentally, we have continued our investigation of axisymmetric laminar flames using laser imaging techniques. We have investigated varying the fuel/diluent ratio. In methane flames,there is a broadband fluorescence that overlaps the Raman wavelengths used to measure the concentration of major species.

13198 (ETDE-mf–1759417) **Numerical simulation of the flame propagation in pre-reacting gases.** Kaufmann, D. Duisburg Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 7 - Maschinenbau. 1 Dec 1989 162p. (In German). Order Number DE91759417. Source: OSTI; NTIS (US Sales Only).

The propagation of free flames in premixed, prereacting fuel gases plays an important part in the combustion process in the otto engine: After each load change and before ignition, combustion is preceded by chemical reactions in the fuels gas filled in which may go as far as auto-ignition and, thus, represent an undesired process course. A one-dimensional numerical model was used to simulate and study the effects of these reactions in the unburnt gas on the propagating flame front. Instationary flame propagation process was interpreted as a superimposition of a time-dependent homogenic gas reaction in the unburnt gas by a stationary flame propagation for a given unburnt-gas condition. Stoichiometric mixtures of each of the fuels H_2, CH_4, and C_2H_6 with pure O_2 were studied as reaction systems. In each reaction system, homogenic gas reaction was studied under both adiabatic-isobaric and isothermal-isobaric boundary conditions. (HK).

13199 (JPL-D–8051) **Spray combustion modeling and evaluation: Annual summary report CY 1990, January 1, 1990–December 31, 1990.** Back, L.H.; Bellan, J.; Kwack, E.; Shakkottai, P.; Harstad, K. Jet Propulsion Lab., Pasadena, CA (USA). 7 Jan 1991. 33p. Sponsored by USDOE,. DOE Contract AI01-86CE90237. Order Number DE91007923. Source: OSTI; NTIS; GPO Dep.

The overall objective of this task is to produce and evaluate a spherically-symmetric, analytical model of multicomponent-fuel spray combustion, including the formation and combustion of cenospheres. It is intended that such a model could ultimately be incorporated into a composite computer program for predicting the performance of industrial furnace and boiler designs fired with arbitrary liquid fuels. The primary objectives for CY 1990 are to: model the evaporation of multicomponent-fuel-sprays; prepare a computer code; prepare a manuscript for publication of this work; initiate multicomponent spray ignition and combustion modeling: and carry out some experiments designed to validate evaporation models developed under this program. 10 refs., 11 figs.

13200 (SAND–90-1851C) **Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system.** Razani, A. (New Mexico Univ., Albuquerque, NM (USA). Dept. of Mechanical Engineering); Shahinpoor, M.; Hingorani, S.L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9010254–2: 32. annual meeting on Pyrotechnics and Explosives Applications Section (ADPA), Albuquerque, NM (USA), 2-4 Oct 1990). Order Number DE91009167. Source: OSTI; NTIS; GPO Dep.

The effect of equations of state on transient burning of pyrotechnic materials burning in a closed system is discussed. The effect of condensed species and appropriate equations of state parameters as generated from chemical equilibrium codes such as the BLAKE and the TIGER are presented. It is shown that defining a co-volume for use in transient burning analysis in the presence of condensed species requires careful considerations. A variable co-volume is defined for use in simplified transient burning analysis. Furthermore, its effect on pressure-time history of pyrotechnic materials burning in a closed system is presented. A pressure dependent co-volume for the analysis of a particular pyrotechnic material greatly simplifies its transient burning analysis under zero-volume firing conditions. The formulation of transient burning in a closed system is developed using the NBS equation of state. 9 refs., 3 figs.

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13201 (DOE/ER–0485P) **Summaries of FY 1990 engineering research.** USDOE Office of Energy Research, Washington, DC (USA). Engineering and Geosciences Div. [1990]. 76p. Sponsored by USDOE,. Order Number DE91008229. Source: OSTI; NTIS; GPO Dep.

The BES Engineering Research Program is one of the component research programs which collectively constitute the DOE Basic Energy Sciences program. The DOE Basic Energy Sciences program supports energy related research in the physical and biological sciences, and in engineering. The chief purpose of the DOE Basic Energy Sciences program is to provide the fundamental scientific base on which identification and development of future, national energy options will depend. The major product of the program becomes part of the body of data and knowledge upon which the applied energy technologies are founded; the product is knowledge relevant to energy exploration, production, conversion and use. The BES Engineering Research Program address the following topics identified as essential to the progress of many energy technologies: Advanced Industrial Technology: improvement of energy conversion and utilization, opening new technological possibilities, and improvement of energy systems. Fluid Dynamics and Thermal Processes: broadening of understanding of heat transfer in nonsteady flows, methodology for reducing vibrations and noise in heat exchangers, and engineering aspects of combustion. Solid Mechanics: continuum mechanics, fracture mechanics, thermomechanical behavior in severe environments, aging & lifetime reliability of structures. Dynamics and Control of Processes and Systems: development and use of information describing system behavior, performance criteria, and theories of control optimization to achieve the best possible system performance subject to known constraints. Mechanical Sciences including Fluid Mechanics heat transfer, and

solid mechanics. System Sciences including process control and instrumentation: and Engineering Analysis including nonlinear dynamics, data bases for thermophysical properties of fluids, and modeling of combustion processes for engineering application.

13202 (ORNL/M–1351) **Engineering Technology Division Long-Range Plan, 1991–1995.** Oak Ridge National Lab., TN (USA). [1995]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91007886. Source: OSTI; NTIS; GPO Dep.

This Engineering Technology Division Long-Range Plan is a departure from planning processes of the past. About a year ago we decided to approach our strategic planning in a very different way. With this plan we complete the first phase of a comprehensive process that has involved most of the Division staff. Through a series of "brainstorming"meetings, we have accumulated a wealth of ideas. By this process, we have been able to identify our perceived strengths and weaknesses and to propose very challenging goals for the future. Early on in our planning, we selected two distinct areas where we desire changes. First, we want to pursue program development in a much more structured and dynamic manner: deciding what we want to do, developing plans, and providing the resources to follow through. Second, we want to change the way that we do business by developing more effective ways to work together within the Division and with the important groups that we interact with throughout Energy Systems. These initiatives are reflected in the plan and in related actions that the Division is implementing. The ETD mission is to perform research, development, conceptual design, analysis, fabrication, testing, and system demonstration of technology essential for (1) nuclear reactor systems and related technologies (2) space and defense systems (3) advanced systems for energy conversion and utilization, and (4) water and waste management systems, and to foster a vigorous program of technology transfer using the best available techniques of technical infusion into the marketplace. In meeting this mission, the Division will institute a documented pollution prevention program, ensure that environmental impact statements are prepared for the supporting program, and adhere to all environmental safety and health requirements. 4 figs., 2 tabs.

4202 Facilities, Equipment, and Techniques

Refer also to citation(s) 12418, 12460, 12461, 12474, 12475, 12506, 12528, 12846, 13193, 13353, 13507, 13616, 13845, 13872, 13922

13203 (CONF-910598–2) **Robust automated inventory control through computer integrated robotics.** Hylton, K.W. (Oak Ridge National Lab., TN (USA)); Coe, R.H. III; Heidle, J.M.; Allen, E.A.T. Oak Ridge National Lab., TN (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 37. Instrument Society of America international instrumentation symposium; San Diego, CA (USA); 5-9 May 1991. Order Number DE91007190. Source: OSTI; NTIS; GPO Dep.

The obstacle of accurate inventory control plagues most facets of industry. The responsibility of tracking inventory is assigned to the operator and is accomplished by generating a paper trail of completed processes. The task of tracking various parts through a system can be efficiently accomplished via automated control through computer integrated robotics. The methodology for precise routing through a sophisticated system will be discussed in detail. The integrated system includes a host computer system running a sophisticated database manipulation package, a gantry system, and ancillary equipment that includes a programmable logic controller (PLC) controlling several pieces of equipment, barcode readers used for human interface, and scales. The host system and gantry will be presented, and a canned package used for database manipulation will be described. The method of historical data collection will be demonstrated. An algorithm for determining permitted subsequent part routes with respect to the present part location will also be described in detail. The integrated system will be presented and discussed to demonstrate the benefits of automated inventory control. 3 refs., 5 figs.

13204 (DOE/EM–0007T-Vol.1) **Environmental restoration and waste management: Robotics technology development program: Robotics 5-year program plan: Volume 1, Executive summary.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (USA). Office of Technology Development. [1991]. 19p. Sponsored by USDOE,. Order Number DE91008026. Source: OSTI; NTIS; INIS; GPO Dep.

This plan covers robotics Research, Development, Demonstration, Testing and Evaluation activities in the Program for the next five years. These activities range from bench-scale R&D to full-scale hot demonstrations at DOE sites. This plan outlines applications of existing technology to near-term needs, the development and application of enhanced technology for longer-term needs, and initiation of advanced technology development to meet those needs beyond the five-year plan. The objective of the Robotic Technology Development Program (RTDP) is to develop and apply robotics technologies that will enable Environmental Restoration and Waste Management (ER&WM) operations at DOE sites to be safer, faster and cheaper. Five priority DOE sites were visited in March 1990 to identify needs for robotics technology in ER&WM operations. This 5-Year Program Plan for the RTDP detailed annual plans for robotics technology development based on identified needs. In July 1990 a forum was held announcing the robotics program. Over 60 organizations (industrial, university, and federal laboratory) made presentations on their robotics capabilities. To stimulate early interactions with the ER&WM activities at DOE sites, as well as with the robotics community, the RTDP sponsored four technology demonstrations related to ER&WM needs. These demonstrations integrated commercial technology with robotics technology developed by DOE in support of areas such as nuclear reactor maintenance and the civilian reactor waste program. 2 figs.

13205 (DOE/EM–0007T-Vol.2) **Environmental restoration and waste management: Robotics technology development program: Robotics 5-year program plan: Volume 2, Program plan.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (USA). Office of Technology Development. [1991]. 93p. Sponsored by USDOE,. Order Number DE91008027. Source: OSTI; NTIS; INIS; GPO Dep.

This plan covers robotics Research, Development, Demonstration, Testing, activities in the Program for the next five years. These activities range from bench-scale R&D to fullscale hot demonstrations at DOE sites. This plan outlines applications of existing technology to near-term needs, the development and application of enhanced technology for longer-term needs, and an initiation of advanced technology development to meet those needs beyond the five-year plan. The objective of the Robotic Technology Development (RTDP) is to develop and apply robotics technologies that will enable Environmental Restoration and Waste Management operations at DOE sites to be safer, faster and cheaper. Five priority DOE sites were visited in March 1990 to identify needs for robotics technology in ER&WM operations. This 5-Year Program Plan for the RTDP detailed annual plans for robotics technology development based on identified needs. This 5-Year Program Plan discusses the overall approach to be adopted by the RTDP to aggressively develop robotics technology and contains discussions of the Program Management Plan, Site Visit and Needs Summary, Approach to Needs-Directed Technical Development, Application-Specific Technical Development, and Cross-Cutting and Advanced Technology. Integrating application-specific ER&WM needs, the current state of robotics technology, and the potential benefits (in terms of faster, safer, and cheaper) of new technology, the Plan develops application-specific road maps for robotics RDDT&E for the period FY 1991 through FY 1995. In addition, the Plan identifies areas where longer-term research in robotics will have a high payoff in the 5- to 20-year time frame. 12 figs.

13206 (DOE/EM–0007T-Vol.3) **Environmental restoration and waste management: Robotics technology development program: Robotics 5-year program plan: Volume 3, Site needs and requirements.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (USA). Office of Technology Development. [1991]. 34p. Sponsored by USDOE,. Order Number DE91008028. Source: OSTI; NTIS; INIS; GPO Dep.

In FY 1990 Robotics Technology Development Program (RTDP) planning teams visited five DOE sites. These sites were selected by the Office of Technology Development to provide a needs basis for developing a 5-Year Plan. Visits to five DOE sites provided identification of needs for robotics technology development to support Environmental Restoration and Waste Management (ER&WM) projects at those sites. Additional site visits will be conducted in the future to expand the planning basis. This volume summarizes both the results of the site visits and the needs and requirements of the priority ER&WM activities at the sites, including potential needs for robotics and remote systems technology. It also discusses hazards associated with the site activities and any problems or technical uncertainties associated with dealing with the hazards in the performance of the ER&WM work. Robotic or remote systems currently under development for remediation projects or waste operations are also discussed. The information in this document is organized principally by site, activity, and priority. Section 2.0, Site Needs, is based on information from the site visit reports and provides a summary which focuses on the site needs and requirements for each priority activity. Section 2.0 also records evaluations and discussions by the RTDP team following the site visit. Section 3.0, Commonality Assessment, documents similar site needs where common, or cross-cutting, robotics technology might be applied to several activities. Section 4.0 contains a summary of the site needs and requirements in tabular form. 1 tab.

13207 (DOE/ER/14042–2) **Research on a reconfigurable modular manipulator system: [Technical progress report].** Khosla, P.K.; Kanade, T. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Electrical and Computer Engineering. [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER14042. Order Number DE91009374. Source: OSTI; NTIS; GPO Dep.

Short communication. MANIPULATORS/design; MANIPULATORS; DESIGN; ROBOTS; DYNAMICS; JOINTS; PROGRESS REPORT

13208 (ETDE-mf–1754644) **An adaptive driver model to assess the driving dynamics of passenger cars in critical situations.** Reichelt, W. Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik. 9 Feb 1990 141p. (In German). Order Number DE91754644. Source: OSTI; NTIS (US Sales Only).

A model was developed to assess vehicle properties in critical driving situations. The model is based on the idea that drivers come to know their cars, behaviour in 'normal situations' and store their knowledge accordingly throughout their driving practice. This experience is simulated in the driver model by a feedback model of the vehicle (control section). Along with the control of track deviation which is always available, transverse acceleration was introduced as an additional control variable. This design allows to simulate real-life alarm reactions. A nonlinear single-track model was used for simulation calculation. Simulation calculations were also performed for track changes to assess the influence of vehicle properties on the driver/car control circuit. 5 car variants with different positions of the centre of gravity were studied. The increasing learning capability of the driver model revealed that the differences in the control-circuit behaviour between the vehicle variants almost disappeared; this approach allows the vehicle properties to be studied for their influence on the driver/car control-circuit behaviour in critical driving situations. (HWJ).

13209 (ETDE-mf–1754792) **Dynamic behaviour of centrifugal pumps with low specific speed during fast speed variation.** Universitaet Stuttgart, Institut fuer Hydraulische Stroemungsmaschinen. Mitteilung. Acosta del Carpio, H. Stuttgart Univ. (Germany, F.R.). Inst. fuer Hydraulische Stroemungsmaschinen; Stuttgart Univ. (Germany, F.R.). Fakultaet 5 - Energietechnik. 1990 155p. (In German). Order Number DE91754792. Source: OSTI; NTIS (US Sales Only).

Calculating unsteady processes in plants including hydraulic turbomachines, there are always steady state characteristics of the engines in use. This is a simplification the effects of which have not been quantified so far. At the example of a double-flow, single stage centrifugal pump of low specific speed, the effects of fast speed variations will be investigated more detailed. All relevant operation modes, i.e. pumping mode, braking mode und turbine mode, will be included. With that, can also be described the behaviour of reversing pumps, which work as turbines, more exact than before. The results of numerous investigations both experimental and theoretical exhibit that the dynamic behaviour is chiefly assigned to inertia effect of the fluid volumina contained in the pump. With respect to these effects a dynamic formulation is developed, the results of which provide a very good approximation to the experimental results. Prompt speed variations especially occur on pump-cutoff, i.e. disconnecting the engine. The same applies to disconnecting centrifugal pumps which are reversing and working in turbine mode. The gradient of time of a centrifugal pump is mainly affected by both the magnitude of the centrifugal masses of the machine and the system of the flow of water in the plant. With the help of computational simulation of fictitiously planned plants gradients of speed has been generated and the results of both the conventional and the extended calculation method were compared to each other. This leads to the statement that on slow running processes the dynamic behaviour of a hydraulic turbomachine can be described by steady state characteristics; compared to fast speed variations, there are differences. (orig./GL).

13210 (EUR–12795) **Cast-iron containers out of low radioactive steel.** Deipenau, H. (Siempelkamp Giesserei G.m.b.H. und Co. 45 - Krefeld (DE)); Seidler, M. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 42p. Contract No. FI1D-0047. Source: OSTI; NTIS (US Sales Only).

Low-level radioactive solid waste from the decommissioning of nuclear installations, if transported and disposed of in large containers, may cause less cutting work and therefore less radiation exposure of the work-force. The use of steel waste from decommissioning for manufacturing large transport and/or disposal containers is a promising route for recycling that waste and for saving storage volume and new resources. It has been demonstrated that it is possible to cast transport and disposal containers for radioactive wastes by using carbon steel waste originating from nuclear installations. A prototype has fulfilled all conditions to reach the qualification as a type A package according to the IAEA Regulations for Safe Transport of Radioactive Material as well as the preliminary conditions of the final repository Konrad.

13211 (KCP–613-4380) **Resistence seam welding thin copper foils.** Hollar, D.L. Jr. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Feb 1991. 39p. Sponsored by USDOE,. DOE Contract AC04-76DP00613. (CONF-9104195–1: 72. annual American Welding Society convention, Detroit, MI (USA), 14-19 Apr 1991). Order Number DE91008988. Source: OSTI; NTIS; GPO Dep.

Use of flat flexible circuits in the electronics industry is expanding. The term "flexible circuits" is defined here as copper foil which has been bonded to an insulating film such as Kapton film. The foil is photo processed to produce individual circuit paths similar to printed circuit boards. Another insulating film is laminated over the conductors to complete the flexible circuit. Flexible circuits, like multiwire cables, are susceptible to electromagnetic radiation (EMR) interference. On multiwire cables the interference problem is mitigated by adding a woven wire braid shielding over the conductors. Shielding on flexible circuits is accomplished by enclosing the circuits in a copper foil envelope. However, the copper foil must be electrically sealed around the flexcircuit to be effective. Ultimately, a resistance seam welding process and appropriate equipment were developed which would provide the required electrical seal between two layers of 2-oz (0.0028-inch thick) copper foil on a 1.1-inch wide, 30-inch long, 0.040-inch thick flexible circuit. 4 refs., 19 figs.

13212 (KFK–4787) **Specification of EDITH motion control system.** Breitwieser, H.; Frank, A.; Holler, E.; Suess, U.; Leinemann, K. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorentwicklung (IRE); Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. Sep 1990. 80p. Order Number DE91759273. Source: OSTI; NTIS (US Sales Only); INIS.

EDITH is an experimental device for in vessel handling at NET/ITER. The purpose of EDITH is: Testing of ABS (articulated boom

system) components; testing and validation of remote handling procedures; testing and validation of ABS end-effectors; testing of ABS control system features and verification of control system concepts. This document, after describing the environment in which the control system is to operate, specifies architecture and functionality to be implemented by the EDITH motion control system software, thereby taking full reference to the control system specification for TARM, which was decided to be the base for the implementation. (orig.).

13213 (LA–11943-MS) **Vibration and shock response of the BEAR [Beam Experiment Aboard a Rocket] payload during launch.** Butler, T.A. Los Alamos National Lab., NM (USA). Feb 1991. 23p. Sponsored by U.S. DOE Contract W-7405-ENG-36. Order Number DE91007863. Source: OSTI; NTIS; GPO Dep.

Shock and vibration data obtained during the ARIES launch of the Beam Experiment Aboard a Rocket (BEAR) payload are presented, along with results from the preflight analysis and shock and vibration tests. Acceleration amplitudes were close to expected values. However, the frequency content of the loads experienced during separation shock was significantly different from that of the loads measured during the payload shock test. This result indicates the need for reevaluating the method of shock testing payloads that are launched with the ARIES booster. 7 refs., 13 figs., 7 tabs.

13214 (PNL-SA–18821) **Robot control system for tank waste retrieval.** Hill, L.F.; Bennett, D.W.; Harrigan, R.W. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 14p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910285–1: American Nuclear Society (ANS) robotics for hostile environments, Albuquerque, NM (USA), 11 Feb 1991). Order Number DE91007900. Source: OSTI; NTIS; GPO Dep.

This paper overviews the potential application of robotics for retrieval of radioactive wastes from storage tanks. In a relatively unstructured work environment, the need is for intelligent robotics control which allows considerable operator freedom yet adjusts details of the operation to accomplish his real objective. This requires the control system to have cognizance of the world environment as well as the special needs of each end-effector.

13215 (SAND–90-0102) **Update of PRONTO 2D and PRONTO 3D transient solid dynamics program.** Attaway, S.W. Sandia National Labs., Albuquerque, NM (USA). Nov 1990. 42p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009183. Source: OSTI; NTIS; GPO Dep.

PRONTO 2D and PRONTO 3D are two- and three-dimensional transient solid dynamics codes for analyzing large deformations of highly nonlinear materials subjected to high strain rates. This newsletter is issued to document changes to these codes. As of this writing, the latest version of PRONTO 2D is Version 4.5.6, and the latest version of PRONTO 3D is Version 4.5.6. This update of the two codes discusses two major modifications to the numerical formulations, three new constitutive models, and the additions and improvements of contact surfaces. Changes in file formats, other miscellaneous revisions, and the availability of PRONTO 2D and PRONTO 3D are also discussed. In addition, updated commands for PRONTO 2D are provided in Appendix A of this newsletter. 29 refs., 12 figs., 2 tabs.

13216 (SAND–90-1742C) **Radioactive material package seal tests.** Madsen, M.M.; Humphreys, D.L.; Edwards, K.R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910577–1: 2. international conference on transportation for the nuclear industry, Bournemouth (UK), 8-10 May 1991). Order Number DE91005865. Source: OSTI; NTIS; INIS; GPO Dep.

General design or test performance requirements for radioactive materials (RAM) packages are specified in Title 10 of the US Code of Federal Regulations Part 71 (US Nuclear Regulatory Commission, 1983). The requirements for Type B packages provide a broad range of environments under which the system must contain the RAM without posing a threat to health or property. Seals that provide the containment system interface between the packaging body and the closure must function in both high- and low-temperature environments under dynamic and static conditions. A seal technology program, jointly funded by the US Department of Energy Office of Environmental Restoration and Waste Management (EM) and the Office of Civilian Radioactive Waste Management (OCRWM), was initiated at Sandia National Laboratories. Experiments were performed in this program to characterize the behavior of several static seal materials at low temperatures. Helium leak tests on face seals were used to compare the materials. Materials tested include butyl, neoprene, ethylene propylene, fluorosilicone, silicone, Eypel, Kalrez, Teflon, fluorocarbon, and Teflon/silicone composites. Because most elastomer O-ring applications are for hydraulic systems, manufacturer low-temperature ratings are based on methods that simulate this use. The seal materials tested in this program with a fixture similar to a RAM cask closure, with the exception of silicone S613-60, are not leak tight (1.0×10^{-7} std cm^3/s) at manufacturer low-temperature ratings. 8 refs., 3 figs., 1 tab.

13217 (SAND–90-2124C) **F111 Crew Escape Module pilot parachute.** Tadios, E.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 6p. Sponsored by U.S. Depar. DOE Contract AC04-76DP00789. Project SM-MMK-87-10-324. (CONF-9104171–5: 11. AIAA aerodynamic decelerator systems technology conference, San Diego, CA (USA), 9-11 Apr 1991). Order Number DE91007573. Source: OSTI; NTIS; GPO Dep.

A successfully deployment of a parachute system highly depends on the efficiency of the deployment device and/or method. There are several existing methods and devices that may be considered for a deployment system. For the F111 Crew Escape Module (CEM), the recovery parachute system deployment is initiated by the firing of a catapult that ejects the complete system from the CEM. At first motion of the pack, a drogue gun is fired, which deploys the pilot parachute system. The pilot parachute system then deploys the main parachute system, which consists of a cluster of three 49-ft diameter parachutes. The pilot parachute system which extracts the F111 Crew Escape Module recovery parachute system must provide reasonable bag strip velocities throughout the flight envelope (10 psf to 300 psf). The pilot parachute system must, therefore, have sufficient drag area at the lower dynamic pressures and a reduced drag area at the high end of the flight envelope. The final design that was developed was a dual parachute system which consists of a 5-ft diameter guide surface parachute tethered inside a 10-ft diameter flat circular parachute. The high drag area is sustained at the low dynamic pressures by keeping both parachutes intact. The drag area is reduced at the higher extreme by allowing the 10-ft parachute attachment to fail. The discussions to follow describe in detail how the system was developed. 4 refs., 10 figs., 2 tabs.

13218 (SAND–90-2158C) **Design and performance of a parachute for the recovery of a 760-lb payload.** Waye, D.E. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-9104171–3: 11. AIAA aerodynamic decelerator systems technology conference, San Diego, CA (USA), 9-11 Apr 1991). Order Number DE91007509. Source: OSTI; NTIS; GPO Dep.

A 26-ft-diameter ribbon parachute deployed using a pilot parachute system has been developed at Sandia National Laboratories for the recovery of a 760-lb payload released at subsonic and transonic speeds. The wide range of deployment dynamic pressures led to the design, utilizing wind tunnel testing and computer simulation, of a unique pilot parachute system verified in full-scale flight tests. Performance data from 20 full-scale flight tests were used to evaluate system performance and structural validity. The concical ribbon parachute design chosen for this development effort follows the practice of previous Sandia National Laboratory parachute development programs for high performance airdropped payloads. The design process for this parachute system included a tradeoff study to evaluate and compare the performance between an equivalent drag area 26-foot-diameter single parachute system and a cluster system of three 14-ft-diameter parachutes. The results showed a small advantage for the cluster system in inflation and initial deceleration characteristics. However, the higher cost, higher weight, greater packing complexity and greater risk involved in the development of the cluster system outweighed the performance advantages and led to the choice of the 26-ft-diameter parachute as the baseline design for the development.

This paper describes the design and performance of the 26-ft-diameter parachute which was chosen for the recovery of a 760-lb payload. The results of 20 full-scale flight test of this parachute system are summarized. 8 refs., 13 figs., 2 tabs.

13219 (SAND–90-2219C) **System identification methods for dynamic structural models of electronic packages.** Martinez, D.R.; Red-Horse, J.R.; Allen, J.J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910438–1: 32. AIAA/ASME/ASCE/AHS/ASC structural dynamics and materials conference, Baltimore, MD (USA), 8-10 Apr 1991). Order Number DE91009169. Source: OSTI; NTIS; GPO Dep.

In this paper we discuss two methodologies for system identification of structure models. Finite element software is coupled with optimization and estimation software to implement the techniques. Both methods update physical parameters in the finite element model and utilize iterative solution techniques. The first method integrates MSC/NASTRAN with a Bayes estimation software tool which is being developed for use with general finite element models. The second method utilizes a math programming optimization technique. Both methods were applied to a finite element model of an electronics package using both simulated and measured data. Results are presented using both eigenvalue and eigenvector data. The results showed the importance of using both eigenvalue and eigenvector data for the model of the electronics package. A discussion of the features of each method is included. 24 refs., 8 figs., 5 tabs.

13220 (SAND–90-2526C) **Developing a brittle fracture acceptance criterion for transport casks for adoption by the International Atomic Energy Agency(IAEA).** Sorenson, K.B. (Sandia National Labs., Albuquerque, NM (USA)); Falci, F.P. Sandia National Labs., Albuquerque, NM (USA). [1991]. 6p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910270–9: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91007730. Source: OSTI; NTIS; INIS; GPO Dep.

With increasing nuclear material transportation demands, new generation casks have included designs which propose the use of structural materials other than austenitic stainless steel. Motivation for using alternate materials include potentials for lower cost, easier fabrication, no welding and less weight (higher payload). Examples of candidate materials for structural components include ferritic steels and ductile cast iron for the containment boundary and borated stainless steel for the basket. The primary technical issue which separates these candidate materials from austenitic stainless steel is that they may, under certain combinations of mechanical and environmental loadings, fail in a brittle fracture mode. There is a clear need to develop a consensus criterion that will encompass a broad range of materials and provide a consistent method for evaluating candidate materials with respect to brittle fracture. Adopting such a criterion through the auspices of the IAEA has distinct advantages. An international consensus would provide assurance to regulators and the public that the most appropriate method is used, and countries developing packages using candidate materials could work with a single criterion without concern that another country is setting precedent using a different criterion. The development of such a criterion has been in progress for two and one-half years. There are two major efforts which are being pursued in parallel. There is the technical effort to write a draft document and the formal effort to facilitate adoption of a criterion by the IAEA. 7 refs., 1 fig.

13221 (SAND–90-2527C) **Results of the first thirty foot drop test of the MOSAIK KfK cask.** Sorenson, K.B.; Salzbrenner, R.; Wellman, G.; Uncapher, W.; Bobbe, J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910270–15: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008256. Source: OSTI; NTIS; INIS; GPO Dep.

The MOSAIK KfK cask, a ductile cast iron (DCI) nuclear material transportation cask donated to Sandia by Gesellschaft fur NuklearService (GNS), was drop tested on June 25, 1990 in Albuquerque, New Mexico. Conditions of the test were; a 30 ft. drop without impact limiters onto an unyielding target, cask metal temperature −16F or below, and a 0.75 inch deep flaw machined into the cask wall at the location of the highest tensile stress. The drop test was successful as judged by inspection of the machined flaw which showed no crack initiation. This drop test, in the first in a series, was designed to demonstrate the viability of using a fracture mechanics approach to design cask fabricated from ferritic materials. In addition, the test demonstrated that a DCI cask can withstand severe impacts under accident-type conditions without failing in a brittle mode. The drop test parameters were designed to produce high decelerations and yield-level stresses in the cask wall. The measured rigid body deceleration was approximately 800 gs. This compares with decelerations of 100 to 300 gs for drop tests of casks with impact limiters. The time to peak load was 1.2 to 2.8 msec., compared to 20 to 40 msec for casks dropped with impact limiters. The maximum strain during the drop test was 1400 microstrain, which equates to a maximum tensile stress of about 37000 psi. This level of stress slightly exceeds the static yield strength and is about 80% of the dynamic yield strength. The test results of this initial drop test are discussed in detail in this paper.

13222 (SAND–91-0420C) **How clean is clean?—How clean is needed?.** Hays, A.K. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910279–6: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991). Order Number DE91008173. Source: OSTI; NTIS; INIS; GPO Dep.

This paper will provide an overview of cleaning qualifications used in a variety of industries: from small-scale manufacturer's of precision-machined products to large-scale manufacturer's of electronics (printed wiring boards and surface mount technology) and microelectronics. Cleanliness testing techniques used in the production of precision-machined products, will be described. The on-going DOD program to obtain high-reliability electronics, through the use of military specifications for cleaning and cleanliness levels, will be reviewed. In addition, the continually changing cleanroom/materials standards of the microelectronics industry will be discussed. Finally, we will speculate on the role that new and improved analytical techniques and sensor technologies will play in the factories of the future. 4 refs., 1 tab.

13223 (SAND–91-0470C) **Fast cook-off testing in enclosed facilities with reduced emissions.** Nakos, J.T.; Kent, L.A.; Gill, W.; Sobolik, K.B. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-9103131–1: Joint Army/Navy/NASA/Air Force (JANNAF) propulsion systems hazards subcommittee meeting, Albuquerque, NM (USA), 18-22 Mar 1991). Order Number DE91008253. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories has utilized pool fires for over thirty years to subject military components, weapon mockups and hazardous material shipping containers to postulated transportation accident environments. Most of the tests have been performed in either open pools or wind shielded facilities with little control of visible smoke emissions. Because of the increased sensitivity of environmental issues and because wind generates the biggest uncontrollable effect on the thermal environment in open pool fires, enclosed test facilities with reduced visible emissions have been developed. The facilities are basically water cooled enclosures fitted with controlled air supply systems and high temperature afterburners. The purpose of this paper is to present our experience with both open and enclosed fires. In the first section, a review of the fire test facilities is given. A following section presents a mathematical model behind our approach to characterizing the fire environment. In the last section, data from open and closed fires are compared.

13224 (UCRL-ID–106509) **Aerodynamics modeling of towed-cable dynamics.** Kang, S.W.; Latorre, V.R. Lawrence Livermore National Lab., CA (USA). 17 Jan 1991. 45p. Sponsored by U.S. DOE Contract W-7405-ENG-48. Order Number DE91008426. Source: OSTI; NTIS; GPO Dep.

The dynamics of a cable/drogue system being towed by an orbiting aircraft has been investigated as a part of an LTWA project for the Naval Air Systems Command. We present here a status report on the tasks performed under Phase 1. We have accomplished the

following tasks under Phase 1: A literature survey on the towed-cable motion problem has been conducted. While both static (steady-state) and dynamic (transient) analyses exist in the literature, no single, comprehensive analysis exists that directly addresses the present problem. However, the survey also reveals that, when judiciously applied, these past analyses can serve as useful building blocks for approaching the present problem. A numerical model that addresses several aspects of the towed-cable dynamic problem has been adapted from a Canadian underwater code for the present aerodynamic situation. This modified code, called TOWDYN, analyzes the effects of gravity, tension, aerodynamic drag, and wind. Preliminary results from this code demonstrate that the wind effects alone CAN generate the drogue oscillation behavior, i.e., the "yo-yo" phenomenon. This code also will serve as a benchmark code for checking the accuracy of a more general and complete "R&D" model code. We have initiated efforts to develop a general R&D model supercomputer code that also takes into account other physical factors, such as induced oscillations and bending stiffness. This general code will be able to evaluate the relative impacts of the various physical parameters, which may become important under certain conditions. This R&D code will also enable development of a simpler operational code that can be used by the Naval Air personnel in the field.

13225 (UCRL-JC–104826) **A new elastoplastic shell element formulation for DYNA3D.** Engelmann, B.E.; Whirley, R.G. Lawrence Livermore National Lab., CA (USA). Aug 1990. 37p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9009348–1: DYNA3D users group conference, Bournemouth (UK), 18-19 Sep 1990). Order Number DE91008456. Source: OSTI; NTIS; GPO Dep.

The analysis of shell structures undergoing dynamic elastoplastic deformation is an important capability of DYNA3D. This paper presents an improved formulation for a 4-node quadrilateral shell element for explicit dynamic analysis. The proposed element is derived from a three-field weak form, and incorporates recently developed assumed strain methods for improved accuracy. In addition, the element is formulated in a large-displacement small-strain setting for minimum cost. Complex nonlinear constitutive models are easily incorporated into this formulation. Numerical examples illustrating the accuracy, robustness, and speed of the new element are shown. 13 refs., 3 tabs.

13226 (UCRL-MA–105268) **NIKE3D: A nonlinear, implicit, three-dimensional finite element code for solid and structural mechanics: User's manual.** Maker, B.N. Lawrence Livermore National Lab., CA (USA). Jan 1991. 119p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009759. Source: OSTI; NTIS; GPO Dep.

This report provides a user's manual for NIKE3D, a fully implicit three-dimensional finite element code for analyzing the finite strain static and dynamic response of inelastic solids, shells, and beams. Spatial discretization is achieved by the use of 8-node solid elements, 2-node truss and beam elements, and 4-node membrane and shell elements. Contact-impact algorithms permit gaps, frictional sliding, and mesh discontinuities along material interfaces. Several nonlinear solution strategies are available, including Full-, Modified-, and Quasi-Newton methods. The resulting system of simultaneous linear equations is either solved iteratively by an element-by-element method, or directly by a factorization method, for which case bandwidth minimization is optional. Data may be stored either in or out of core memory to allow for large analyses. 38 refs.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 12868

13227 (AEEW-R–2603) **SIMone user's manual. V. 2.1.** Silk, M. AEA Technology, Winfrith (UK). Mar 1990. 27p. Order Number DE91622705. Source: OSTI; NTIS (US Sales Only); INIS.

Simone is a computer application program which provides an environment in which to run the nuclear reactor thermal hydraulic simulation code RELAP5. It enables users to run a RELAP5 calculation on-line on a SUN4 workstation, and provides an interactive means of executing operator-like actions. In addition, a version of the graphical post-processing tool ISOVU is incorporated, allowing a real-time display of the RELAP5 calculation to be presented in the form of a system mimic diagram. This report comprises a description of the facilities available within the Simone application, and a user guide describing the user interface. (author).

13228 (CONF-910561–1) **Dynamic tube/support interaction in heat exchanger tubes.** Chen, S.S. Argonne National Lab., IL (USA). [1991]. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 5. international conference on flow induced vibrations; Brighton (UK); 21-23 May 1991. Order Number DE91006089. Source: OSTI; NTIS; GPO Dep.

The supports for heat exchanger tubes are usually plates with drilled holes; other types of supports also have been used. To facilitate manufacture and to allow for thermal expansion of the tubes, small clearances are used between tubes and tube supports. The dynamics of tube/support interaction in heat exchangers is fairly complicated. Understanding tube dynamics and its effects is important for heat exchangers. This paper summarizes the current state of the art on this subject and to identify future research needs. Specifically, the following topics are discussed: dynamics of loosely supported tubes, tube/support gap dynamics, tube response in flow, tube damage and wear, design considerations, and future research needs. 55 refs., 1 fig.

13229 (Juel–2384) **Calculation of the local heat transfer in the entrance region of pipes with variable cross sections and variable properties.** Rechenauer, C.; Achenbach, E. Forschungszentrum Juelich GmbH (KFA) (Germany, F.R.). Inst. fuer Energieverfahrenstechnik. Sep 1990. 85p. (In German). Order Number DE91759216. Source: OSTI; NTIS (US Sales Only); INIS.

Hot gas is fed into a heat exchanger and is cooled down there. High local heat transfer coefficients arise in the inlet region of the water-cooled nozzle due to the entrance effect in the boundary layer which may result in the wall becoming locally overheated. In order to specify the most favourable form possible for the inlet, the local heat transfer is calculated for cyclindrical pipe geometries with a rounded inlet and for conical pipe geometries similarly with a rounded inlet. To this end, the velocity field of the flow is first determined with the aid of the potential theory. The resulting velocity distribution along the inlet contour is used, via a boundary layer calculation, to determine the velocity and temperature profile and thus also the local Nusselt number along the contour. Studies are made both of laminar and also of the subsequent turbulent flow, including the transition point. The properties may be regarded as variable. The differential equation system is solved by a numerical finite-difference method after implementation of the Mangler and the Blasius transformations. The theoretical results are in good agreement with own experimental results. The maximum Nusselt numbers are determined for the cylindrical pipe inlet at the transition point 'laminar-turbulent' which is observed near the transition from the inlet curvature into the pipe. Even for large curvature radii they are clearly above the maximum values occurring for the conical pipe inlet. For the latter geometry the critical position is at the transition from the cone to the cylindrical pipe. The thermal stresses on the tube material are thus lower for the conical pipe inlet than for the cylindrical geometry. (orig.).

13230 (PSI–71, pp. 40-53) **The NEPTUN experiments on LOCA thermal-hydraulics for tight-lattice PWRs.** Dreier, J. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Chawla, R.; Rouge, N.; Yanar, S. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1990. In *Contributions to technical and economic aspects of high converters.* 62p. Order Number DE91003073. Source: OSTI; NTIS (US Sales Only); INIS.

The NEPTUN test facility at the Paul Scherrer Institute is currently being used to provide a broad data base for the validation of thermal-hydraulics codes used in predicting the reflooding behaviour of a tight-lattice PWR (light water highb conversion reactor, LWHCR). The present paper gives a description of the facility and the matrix to be covered in the experimental program. Results are presented from a number of forced-feed, bottom-reflooding experiments, comparisons being made with (a) measurements carried out earlier for standard-PWR geometry and (b) the results of a calculational benchmark exercise conducted in the framework of a

Swiss/German LWHCR-development agreement. Rewetting for the tight, hexagonal-geometry (p/d = 1.13) NEPTUN-III test bundle has been found to occur in all tests carried out to date, in which reasonably LWHCR-representative values for the various thermal-hydraulics parameters are used. Results of the calculational benchmark exercise have confirmed the need for further code development efforts for achieving reliable predictions of LWHCR reflooding behaviour. (author) 11 figs., 3 tabs., 3 refs.

13231 (PSI–79) **Reflood experiments under nontypical flow conditions of alternatively high liquid velocities, plug flow and wet steam flow.** Luebbesmeyer, D. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Oct 1990. 61p. (In German). Order Number DE91622707. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes results of reflood experiments in the directly heated tube (14 mm diam, 1.4 m length) of the PEANUT rig. The experiments were performed in the pressure range of 0.2 to 0.6 MPascal with high flooding velocities up to 2.2 m/s, as well as limited amount of water and alternatively with wet steam flow. In addition, some of the experiments were compared to the results of calculations with the thermohydraulic code RELAP5/Mode2.5. A first series of experiments was devoted to reflood with entrance velocities between 0.2 and 2.2 m/s. A second series dealt with intermediate liquid and steam flow at the entrance of the test section to simulate a kind of plug flow within the test section. An attempt was made to simulate these experiments with the RELAP5/Mod2.5 code but the results were poor for liquid velocities higher than 0.5 m/s. The third series of experiments was devoted to reflood experiments with a limited amount of water, i.e. the content of a container (220 ml max) mounted directly at the entrance of the test section was blown into it by high velocity steam. It was found that a small amount of water (i.e. some water droplets in the steam flow) is enough to partly quench the test section (for 220 ml of water, half of the test section could be quenched). On the other hand, dry steam flow only cooled the test section but did not quench it. Again, an attempt was made to simulate these experiments with RELAP5/Mod2.5, but the code failed to handle the problem of steam water mixing in the container at low pressure (0.2 MPascal) during the period when the steam starts to blow the water out of the container into the test section. (author) 3 refs., 36 figs., 4 tabs.

4205 Materials Testing

Refer also to citation(s) 12362, 12573, 12635, 12832, 12833, 12834, 12885, 13125, 13339, 13839

13232 (EUR–12727, pp. 23-38) **Application of image processing techniques in dimensional analysis.** Van Otterdijk, K.H. (Netherlands Energy Research Foundation Petten, (NL)); Leeflang, H.P.; Markgraf, J.F.W. Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

The Petten Neutron Radiography Services comprise specialized laboratories equipped with dedicated facilities for handling, processing and investigating of all types of NR films. Included is a PC based image analysis system, used among other things for dimensional analysis of neutron radiographed objects. The contribution focuses on a short description of the system and its usefulness for dimensional measurements. Various software routines were investigated and applied to the Riso Calibration Fuel Pin.

13233 (EUR–12727, pp. 39-51) **Comparison of optical density profiles from a travelling microdensitometer and a PC based image analysis system.** Van Otterdijk, K.H. (Netherlands Energy Research Foundation Petten, (NL)); Leeflang, H.P.; Markgraf, J.F.W. Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

Within the Petten Neutron Radiography Services (PNRS) a PC based image analysis system is operational. The system is available among others for deriving optical density profiles from digitized images with very high speed. Because of many advantages, inherent to such a system, it is wise to consider the replacement of the existing computer controlled travelling microdensitometer. Therefore both systems are evaluated in terms of specifications; a number of optical density profiles of transversal fuel pin scans and the effect of dimensional analysis routines are compared. Likewise resolution parameters, derived from a neutron radiographic knife edge, are considered.

13234 (EUR–12727, pp. 53-64) **The practical utilization of nitrocellulose film in neutron radiography.** Markgraf, J.F.W. (Commission of the European Communities, Petten (NL). Joint Nuclear Research Center). Commission of the European Communities, Luxembourg (Luxembourg). Mar 1990. (CONF-890554–: 3. world conference on neutron radiography, Osaka (Japan), 14-18 May 1989). In *Neutron radiography at the HFR Petten.* 90p. Order Number DE91752662. Source: OSTI; NTIS (US Sales Only).

The direct image capability without activation plus the simple handling and processing, are the main favourable characteristics of nitrocellulose film application in neutron radiography. The Neutron Radiography Working Group (NRWG) has compiled detailed information on the practical utilization of nitrocellulose film. This information will be published within the series of topical reports prepared and edited by the NRWG. This contribution summarizes and highlights the main chapters of the anticipated NRWG publication.

13235 (KFK–4796) **Perturbation compensating procedure for instrumented impact tests.** Wassilew, C. (Karlsruhe Univ. (T.H.) (Germany, F.R.)); Rieth, M.; Dafferner, B. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. Oct 1990. 21p. (In German). Order Number DE91754839. Source: OSTI; NTIS (US Sales Only); INIS.

The existing evaluation instructions for instrumented impact tests are insufficient. The determination of the material specific internal variables is therefore inaccurate. The material specific variables determined from very simple and apparently well structured curves carried out by different persons show considerable biases. To reduce these uncertainties to a minimum, a perturbation compensating procedure has been developed. The procedure renders a objective, uniform, thereby reproducible and more accurate evaluation of the material specific internal variables supplied by instrumented impact tests. The procedure bases upon methods of signal processing and generates a perturbation free force-strain curve. The elastic range of the force-strain curve as well as the different plastic ranges and the crack initiation respectively the crack arrest variables obtained by implementing the procedure mentioned above are definitely more closely related to the true material characteristics compared with previous evaluation methods. The perturbation compensating procedure can be adapted to existing computer based evaluation systems. (orig.).

13236 (SAND–91-0400C) **Experimental laboratory system to generate high frequency test environments.** Gregory, D.L.; Paez, T.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910531–2: 37. annual technical meeting and equipment exposition of the Institute of Environmental Sciences (IES), San Diego, CA (USA), 6-10 May 1991). Order Number DE91008252. Source: OSTI; NTIS; GPO Dep.

This is an extension of two previous analytical studies to investigate a technique for generating high frequency, high amplitude vibration environments. These environments are created using a device attached to a common vibration exciter that permits multiple metal on metal impacts driving a test surface. These analytical studies predicted that test environments with an energy content exceeding 10 kHz could be achieved using sinusoidal and random shaker excitations. The analysis predicted that chaotic vibrations yielding random like test environments could be generated from sinusoidal inputs. In this study, a much simplified version of the proposed system was fabricated and tested in the laboratory. Experimental measurements demonstrate that even this simplified

system, utilizing a single impacting object, can generate environments on the test surface with significant frequency content in excess of 40 kHz. Results for sinusoidal shaker inputs tuned to create chaotic impact response are shown along with the responses due to random vibration shaker inputs. The experiments and results are discussed. 4 refs., 5 figs.

13237 (UCRL-ID–104929) **Tensile testing at high temperatures in a glovebox.** Stratman, M.P. Lawrence Livermore National Lab., CA (USA). 1 Oct 1990. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008994. Source: OSTI; NTIS; GPO Dep.

An apparatus has been designed and fabricated to perform high-temperature tensile tests in a glovebox environment. This apparatus was used to accomplish both high-temperature tensile tests and tests in a liquid metal environment. 3 figs.

4210 Combustion Systems

Refer also to citation(s) 12389, 12639

13238 (CONF-9009198–1) **Advanced two-stage incinerator.** Rehmat, A.; Khinkis, M. Institute of Gas Technology, Chicago, IL (USA). [1990]. 18p. Sponsored by Ins. From Annual conference of the Hazardous Materials Control Research Institute (HMCRI): Great Lakes '90; Cleveland, OH (USA); 26-28 Sep 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology (IGT) is developing an advanced incinerator that combines the fluidized-bed agglomeration/incineration and cyclonic combustion/incineration technologies that have been developed separately at IGT over many years. This combination results in a unique and extremely flexible incinerator for solid, sludge, liquid, and gaseous wastes. This system can operate over a wide range of conditions in the first stage, from low temperature (desorption) to high temperature (agglomeration), including gasification of high-Btu wastes. In the combined system, solid, liquid, and gaseous organic wastes would be easily and efficiently destroyed [>99.99% destruction and removal efficiency (DRE)], whereas solid inorganic contaminants would be contained within a glassy matrix, rendering them benign and suitable for disposal in an ordinary landfill. This technology is different from other existing technologies because of its agglomeration and encapsulation capability and its flexibility with respect to the types of wastes it can handle. Both the fluidized-bed as well as the cyclonic incineration technologies have been fully developed and tested separately at pilot scales. 12 refs., 4 figs., 4 tabs.

13239 (CONF-9010197–3) **Advanced multipurpose incinerator.** Rehmat, A.; Khinkis, M. Institute of Gas Technology, Chicago, IL (USA). [1990]. 17p. Sponsored by Ins. From American flame research committee 1990 fall international symposium; San Francisco, CA (USA); 8-10 Oct 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The Institute of Gas Technology (IGT) is developing an advanced multipurpose incinerator that combines the fluidized-bed agglomeration/incineration and cyclonic combustion/incineration technologies that have been developed separately at IGT over many years. This two-stage combination results in a unique and extremely flexible multipurpose incinerator for solid, sludge, liquid, and gaseous wastes. This system can operate over a wide range of conditions in the first stage, from low temperature (desorption) to high temperature (agglomeration), including gasification of high-Btu wastes. In the combined system, solid, liquid, and gaseous organic wastes would be easily and efficiently destroyed [>99.99% destruction and removal efficiency (DRE)], whereas solid inorganic contaminants or solid residue would be contained within a glassy matrix, rendering them benign and suitable for disposal in an ordinary landfill. This technology is different from other existing technologies because of its agglomeration and encapsulation capability and its flexibility with respect to the types of wastes it can handle. Both the fluidized bed as well as the cyclonic incineration technologies have been fully developed and tested separately at pilot scales. 12 refs., 4 figs., 4 tabs.

13240 (SVF–385) **Measurement and analysis tool for minimizing NO_x, SO_2 and CO by using process identification.** Bergdahl, B.G. (Studsvik Nuclear, Nykoeping (Sweden)); Oguma, Ritsuo. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Nuclear, Nykoeping (Sweden). Dec 1990. 73p. (In Swedish). (STUDSVIK-NI–89-26). Order Number DE91753082. Source: OSTI; NTIS (US Sales Only).

The presented method estimates the couplings described with the classical method of investigation but without any change in operation of the furnace. The method is called process identification and is based on correlation between different signals. The method has been applied for many years mainly within nuclear power applications. The measurements were performed at Kopparfors AB in Fors, Sweden, and the combustion in a CFB was the goal for the investigation. The combustor is used for high pressure steam production. The maximum power is 56 MW. The combustor was fired with coal without adding limestone to the process during the experiment period. The results show that the applied method works nicely as a tool to find the couplings between the signals. The measurements performed with the controllers in automatic mode give noise signals suitable for the analysis. On the other hand signals recorded in manual mode does not give enough noise for the analysis. The goal for the method presented in the report is a decision tool for the operator. If the operator wants to lower the temperature in the furnace 5 deg C the CRT will tell him how much (in m^3/s) he should increase the recirculating exhaust gas. The information about the process is continuously updated via measurements. (authors).

4220 Mining and Underground Engineering

Refer also to citation(s) 12362, 12509

4230 Marine Engineering

13241 (STF–20A90035) **Remotely operated subsea machine tool system.** Husebye, R.E. (Statoil, (NO)); Jenssen, H.P. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Mar 1990. 15p. Order Number DE91753006. Source: OSTI; NTIS (US Sales Only).

Paper from Conference UTC'90, Bergen 18-21 March.

The Norwegian oil company STATOIL and the Foundation for Scientific and Industrial Research at the University of Trondheim (SINTEF) have jointly developed a concept for a remotely operated subsea machine tool system for deepwater precision machining and inspection. The system is designed for water depths down to 400 meters. The system will be run on guidelines and will be operated from a monohull vessel or rig. The remotely operated machine tool system will be used for remachining various damages on seal surfaces on wellheads, permanently mounted flanges and multibore connectors subsea. In this way production delays and losses might be avoided, and wells might be saved from abandonment. The machine tool system is operated through a dedicated Computer Numerical Control System (CNC) which permits the operator to perform both manual and automatic machining and inspection/documentation operations. The remotely operated subsea machine tool system is developed to a stage where a complete prototype system can be built and demonstrated. 7 figs.

13242 (STF–20A90036) **SUBMATIC - Remotely Operated Subsea Machine Tool and Inspection CNC-system.** Bjoerke, Oe. (Statoil (NO)); Husebye, R.E.; Jenssen, H.P. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Mar 1990. 27p. Order Number DE91753007. Source: OSTI; NTIS (US Sales Only).

The Norwegian oil company STATOIL and the Foundation for Scientific and Industrial Research at the University of Trondheim (SINTEF) have jointly developed a remotely operated subsea machine tool system for deepwater machining and inspection of subsea wellheads and multibore connectors. The system is designed for water depths down to 400 meters. The project has been initiated and funded by STATOIL, while the project work has been carried out by SINTEF. The system will provide a number of

optional machining operation together with specific inspection systems for dimension and surface roughness documentation both before and after machining. 11 refs.

4250 Power Cycles

Refer also to citation(s) 12641

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 12810, 13266, 13267, 13328, 13810, 13883

13243 (BNL–45415) **Amplification of femtosecond pulses using a N_2 pump laser.** Srinivasan-Rao, T.; Tsang, T.; Fischer, J. Brookhaven National Lab., Upton, NY (USA). Nov 1990. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910595–5: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91008413. Source: OSTI; NTIS; INIS; GPO Dep.

We have amplified the CPM output by pumping an axicon Bethune dye cell with N_2 laser obtaining 1 μJ in 150 fs with signal to noise ratio of >200 and Gaussian spatial profile. System performance for various input pulse durations and methods to increase the amplified energy will be discussed. 3 figs.

13244 (BNL–45824) **Scaling relations and parameters for 1 Å FEL.** Yu, L.H. Brookhaven National Lab., Upton, NY (USA). [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9004232–6: Prospects for a 1 Angstrom Free-Electron Laser (FEL) workshop, Sag Harbor, NY (USA), 22-27 Apr 1990). Order Number DE91009441. Source: OSTI; NTIS; INIS; GPO Dep.

The Free Electron Laser (FEL) holds great promise as a tunable source of coherent radiation. At the present, the shortest wavelength achieved by an FEL is 2500 Å. However, as recent progress in the development of laser driven photocathode electron guns has provided electron beams with lower and lower emittance and higher and higher current, it has become clear that FEL's with much shorter wavelength can be achieved. An FEL operating below 1000 Å will yield important advances in fields such as photochemistry, atomic and molecular physics. An FEL with wavelength of 30 Å will bring new era to the development of holography of living cells. And, if an FEL with 1 Å wavelength can be developed, its impact on solid physics, molecular biology, and many other fields can hardly be exaggerated. We first describe our electron distribution model: a waterbag transverse phase space distribution and a Gaussian energy distribution. This model is widely used in simulations, and is rather close to reality. Then we describe the dispersion relation derived from the Vlasov-Maxwell equations, and its solution, expressed in scaled form. We compare the variational approximation with several simulation codes. Then we compare with exact results which we have derived for a parallel electron beam with finite beam size and energy spread. We explain the scaling relations, and give examples to show how system parameters scale when the FEL wavelength is reduced. Then, applying these scaling relations, we derive a list of preliminary system parameters for a 1 Å FEL. As an example, we apply our analytical calculation to optimize one set of parameters derived from the scaling relations. Finally, as a conclusion we discuss the implication of the list of parameters for a 1Å FEL. 20 refs., 4 figs.

13245 (ENEA-RT-TIB–89-71) **Numerical study of high gain excimer amplifier.** Flora, F.; Hermsen, T. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. Sep 1990. 32p. (RT/TIB–89-71). Order Number DE91752881. Source: OSTI; NTIS (US Sales Only).

For the realization of a combined oscillator-amplifier laser system, known as Master-Oscillator-Power-Amplifier (MOPA), for high gain excimer active media, often an empirical way is followed in order to get high performances. This paper presents an extensive numerical study (based on the integration of the Rigrod equation) of the power extraction efficiency of an amplifier for different geometries, including multiple pass and beam expansion in one or two dimensions, and for different gain and absorption coefficients. The use of normalized dimensionless parameters (for the input power, active medium size, etc.) gives the results a universal validity and facilitates the design of amplifiers for a broad range of beam geometries, e.g., multiple pass, expanding, etc.

13246 (ENEA-RT-TIB–89-74) **Compact code for theoretical modelling of discharge-pumped XeCl lasers.** Letardi, T.; Fang, H.; Fu, S. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. 1990. 39p. (RT/TIB–89-74). Order Number DE91752916. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the development of a compact code for the theoretical modelling of discharge-pumped XeCl lasers in which superelastic collisions and electron-electron interactions are excluded. The code was used to model an X-ray preionized XeCl laser and a good agreement between the modelling and experiments was obtained. The approximations introduced by neglecting superelastic collisions and electron-electron interactions are studied in detail.

13247 (ETDE-IT–91-09) **Cavity length adjustment and output FEL intensity optimization.** Dattoli, G.; Giannessi, L.; Loreto, V.; Mari, C. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1990. 15p. Order Number DE91752866. Source: OSTI; NTIS (US Sales Only).

Based on a practical formula (modified to include saturation effects due to intensity intra-cavity growth) for the gain of a free electron laser (FEL) oscillator operating with a pulsed electron beam, this paper reconsiders, in more quantitative details, the possibility of enhancing the output FEL intensity, by adjusting the cavity length while the signal grows.

13248 (FASAC-TAR–91007476) **Soviet phase conjugation research.** Fisher, R.A.; Boyd, R.W.; Klein, M.B.; Kurnit, N.A.; Milonni, P.W.; Rockwell, D.A.; Yeh, P. Science Applications International Corp., McLean, VA (USA). Foreign Applied Sciences Assessment Center. Sep 1990. 232p. Source: OSTI; Science Applications International Corporation, 1710 Goodridge Drive, P.O. Box 1303, McLean, VA 22102.

Optical phase conjugation is a Soviet-discovered technique that applies nonlinear optical effects to automatically manipulate laser beams while automatically correcting for arbitrary distortions. Optical phase conjugation can aid in providing improved configurations for average-power and high-peak-power laser systems; it can provide nearly automatic pointing and tracking laser systems; and it can provide many other practical applications (both military and nonmilitary). Here it is important to note that 100- to 1000-watt systems are also of significant importance, not just ultra-high-energy or high-power lasers designed to do significant structural damage at significant distances. One class of phase conjugation techniques, namely, stimulated Brillouin scattering, along with its four-wave mixing counterpart, Brillioun-enhanced four-wave mixing, has been the hallmark of the Soviet effort – with nearly all contributions (both theoretical and experimental) arising from the Soviet Union. Both stimulated Brillouin scattering and Brillouin-enhanced four-wave mixing arise from the same electrostrictive nonlinearity, where the presence of a gradient in the optical intensity produces a force on the fluid. Scientists in the United States started studying optical phase conjugation approximately five years after Soviet scientists, and initially concentrated on areas quite different from those of Soviet emphasis.

13249 (FASAC-TAR–91007477) **Soviet and East European research related to molecular electronics.** Conrad, M.E.; Birge, R.R.; Lafrate, G.J.; Potember, R.S.; Salemme, F.R.; Tien, H.T. Science Applications International Corp., McLean, VA (USA). Jul 1990. 231p. Source: OSTI; Science Applications International Corp., 1710 Goodridge Drive, P.O. Box 1303, McLean, VA 22102.

Six US scientists, each an expert in one or more of the pertinent disciplines, prepared this assessment of Soviet and East European molecular electronics research. The assessment includes a survey of experimental and theoretical model systems under study in the Soviet Union and Eastern Europe and an analysis of computer architecture concepts that are guiding research. It also examines research on organic molecules that could serve a switching function, protein engineering, biosensors that integrate membranes and molecular components (such as proteins), protein-membrane systems that serve as optomolecular electronic storage, and memory

devices. The Soviet program is coherent and includes multiple approaches and objectives. East European countries have developed individual programs with a variety of special emphases. These programs are part of the national biotechnology efforts. Basic scientific work is at a high level. Technologies required for eventual implementation are developing in a broad-front manner, but with weakness associated mainly with conventional computer and automation technologies persisting. Soviet investigators have used bacteriorhodopsin, a photosynthetic bacterial protein, to fabricate a photochromic film called Biochrome that has been used in a prototype molecular optoelectronic memory storage and retrieval system. This is a milestone achievement in the field of molecular electronics, demonstrating that proteins and membranes can be used effectively for a significant computer function. Other areas of strength include elucidation of information processing within neurons and use of optically active dynamic chemical processes for image processing.

13250 (SAND–90-2552) **Optical properties of a nuclear reactor pumped gas laser.** Corvo, A. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 42p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009226. Source: OSTI; NTIS; INIS; GPO Dep.

Ray paths and focal lengths are derived to fourth order for a nuclear-reactor wall-pumped gas laser. Ray paths in the laser gain cell are shown to be nearly random for a long gain region. Focal lengths calculated from the ray paths exiting the laser are shown to oscillate between $\pm \infty$ during pumping. The use of stimulated Brillouin scattering as a means for beam clean-up is discussed with the conclusion that the phase conjugated beam would cycle on and off as the ray paths and focal lengths oscillate between extremes. The parameters determining this cycling effect and its characteristics are also derived. 17 refs., 11 figs., 1 tab.

13251 (SAND–90-2998C) **High efficiency surface-emitting semiconductor laser resonators.** Gourley, P.L. (Sandia National Labs., Albuquerque, NM (USA)); Warren, M.E.; Vawter, G.A.; Hadley, G.R.; Brennan, T.M.; Hammons, B.E.; Dawson, L.R.; Schaus, C.F.; Sun, S.; Stover, J.C.; Berent, M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910595–1: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91005236. Source: OSTI; NTIS; GPO Dep.

We have synthesized a new tool, a lasing phase diagram, for designing high efficiency surface-emitting laser resonators and have demonstrated its usefulness by fabricating and operating many different laser resonators. 4 refs., 4 figs.

13252 (SAND–90-3122) **A discussion of the xenon laser intensity as a function of pump rate.** Brannon, P.J. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 9p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009225. Source: OSTI; NTIS; GPO Dep.

The output intensity of a laser can be expressed in the form $I_{out} = Ag_0I_s + BI_s$. The constants A and B are independent of the pump rate for laser systems with nonsaturable losses, but both g_0I_s and I_s can depend upon the pump rate. Methods for determining the pump rate dependence of g_0I_s and I_s are given for experiments in which the pump rate varies continuously. 6 refs., 1 fig.

13253 (SAND–91-0412C) **Theory of semiconductor laser feedback instability.** Lindberg, M. (Arizona Univ., Tucson, AZ (USA). Optical Sciences Center); Rose, M.; Sargent, M. III; Koch, S.W.; Chow, W. Sandia National Labs., Albuquerque, NM (USA). [1991]. 8p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA); North Atlantic Treaty Organization, Brussels (Belgium). DOE Contract AC04-76DP00789. (CONF-910595–4: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91008198. Source: OSTI; NTIS; GPO Dep.

A semiconductor laser coupled to an external cavity is investigated using a composite-cavity mode approach. Strong frequency hopping for small cavity length changes is obtained, indicating instability of the laser operation against cavity lengths fluctuations. 2 refs., 3 figs.

13254 (UCRL-JC–104394) **Toward high brightness, multi-kilowatt solid state lasers.** Zapata, L.E.: Manes, K.R. Lawrence Livermore National Lab., CA (USA). Nov 1990. 25p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9011155–2: 9. international congress on he applications of lasers and electro-optics: ICALEO '90, Boston, MA (USA), 4-9 Nov 1990). Order Number DE91008990. Source: OSTI; NTIS; INIS; GPO Dep.

High average power (HAP) solid state laser output with improved beam quality has introduced new capabilities in materials processing. At the 500 W level and with a beam quality of a "few" times the diffraction limit, the General Electric NY slab is able to drill 5 cm of stainless steel in a few seconds. We expect that 2–3 kW of near infrared laser output in a low order spatial mode would enable metal working now unknown to industry. The HAP output of slab lasers is limited by the size of the available laser crystals and the pump power. Core free, six cm diameter NY boules have been grown on an experimental basis. High optical quality NG can be obtained up to 10 cm in diameter. We present the results of our modeling based on these crystals pumped by advanced arc-lamps or laser diode arrays. We project HAP laser outputs of 1.6 kW from an existing Vortek pumped NG oscillator and about 2 kW from diode pumped NY device. Several kW of laser output can be expected from two such slabs in a MOPA configuration before optical damage limits are reached. The three dimensional stress-optic code which we used to optimize our designs, was normalized to available experimental data obtained with the above NG slab at the 500 W level and a 40 W diode pumped NY test bed. Our calculations indicate the essential parameters for attainment of high beam quality. Cooling uniformity across the pumped faces of the slab is critical and the location of the transition between pumped and un-pumped regions towards the slab tips is very important. A flat pumping profile was found to be desirable and predicted one wave of distortion which should be correctable over about 75% of the aperture however, an even better wavefront was predicted over 90% of the aperture when the regions near the edges of the slab were slightly over-pumped relative to the central regions and the regions near to the ends were tapered to compensate for transition effects.

13255 (UCRL-JC–104407-Rev.1) **Recombination x-ray laser experiments using exploding ribbon Al targets: Revision 1.** Keane, C.J.; Eder, D.C.; MacGowan, B.J.; Matthews, D.L.; Whelan, D.A. Lawrence Livermore National Lab., CA (USA). 8 Jan 1991. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9009266–10-Rev.1: 2. international colloquium on X-ray lasers, York (UK), 17-21 Sep 1990). Order Number DE91007146. Source: OSTI; NTIS; GPO Dep.

Results from recent recombination x-ray laser experiments carried out on the Nova laser using exploding ribbon Al targets irradiated with 100 ps pulses of 0.53-μm light are described. Data showed, however, that the plasma was insufficiently ionized to produce recombination pumped gain in H-like AL. Some evidence of weak amplification was seen for several transitions in He- and Li-like Al and H-like O. It is clear for the target and irradiation conditions studied that stimulated emission did not dominate over spontaneous emission for the candidate lasing lines. 9 refs., 3 figs.

13256 (UCRL-JC–105424) **The theory of temporal compression of intense pulses in a metal vapor.** Shaw, M.J.; Crane, J.K. Lawrence Livermore National Lab., CA (USA). 16 Nov 1990. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910595–2: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91005059. Source: OSTI; NTIS; GPO Dep.

We examine compression of near-resonant pulses in metal vapor in the nonlinear regime. Our calculations examine nonlinear effects on compression of optimally-chirped pulses of various fluences. In addition, we compare model predictions with experimental results for compression of 4 nsec Nd:YAG pumped dye pulses.

13257 (UCRL-JC–105541) **Laser pulse compression in strontium and calcium vapor.** Crane, J.K.; Cooke, J.D.; Shaw, M.J.; Presta, R.W.; Christensen, J.J.; Johnson, M.A.; Friedman, H.W.; Paisner, J.A. Lawrence Livermore National Lab., CA (USA). 16 Nov 1990. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910595–3: CLEO '91:

conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91007346. Source: OSTI; NTIS; INIS; GPO Dep.

Application of vapor pulse compression for increasing the intensity of a large copper vapor laser pumped dye laser for x-ray generation is limited by collisional absorption and nonlinear pulse breakup. We discuss measurements of these effects. 7 refs., 1 fig., 11 tabs.

13258 (UCRL-JC–105613) **Progress toward steady-state, high-efficiency vircators.** Poulsen, P.; Pincosy, P.A.; Morrison, J.J. Lawrence Livermore National Lab., CA (USA). 5 Dec 1990. 13p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910123–11: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91008064. Source: OSTI; NTIS; GPO Dep.

The resonance at which high-efficiency operation of virtual cathode oscillators is obtained occurs when the beam frequency equals the reflex frequency to within 2%. This tolerance limit in the frequency ratio implies that cathode closure in the anode-cathode gap is not acceptable. We have developed and tested a 6-cm^2 cathode that will operate longer than 1 μs at 300 A/cm^2 without significant closure. As yet, the full-scale (>80-cm^2) cathode has not worked quite as well. In many tests, the cathode will operate in the emission-limited temperature/field (T/F) mode for approximately 300 ns, and then transition into explosive emission with a relatively slow (~0.5 cm/μs) closure rate. The current density was 45 to 90 A/cm^2. We have not run high-power rf-emission tests under conditions where the diode stays open and in resonance for the duration of the rf pulse at a current density of 250 A/cm^2, which is required for 3-GHz operation; that test remains the focus of our continuing research. We have obtained long (600-ns) duration rf pulses at low power. We have also extended the data base on microwave generation at lower power and have shown that high-efficiency resonances will occur when a multiple of the reflex frequency equals the beam frequency. This allows greater flexibility in the design and scaling of the microwave device. 6 refs., 14 figs.

13259 (UCRL-JC–105655) **Evaluation of modified log-periodic antennas for transmission of wide-band pulses.** Burke, G.J. Lawrence Livermore National Lab., CA (USA). 31 Jan 1991. 12p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9103123–2: 7. annual review of progress in applied computational electromagnetics, Monterey, CA (USA), 19-21 Mar 1991). Order Number DE91008455. Source: OSTI; NTIS; GPO Dep.

Modified forms of the long-periodic dipole antenna have been proposed in the literature for radiating a short pulse with minimum distortion and also for a phase response tailored to compress a linear FM pulse. These designs are reviewed, and the antennas are evaluated by numerical modeling with the frequency domain code NEC. Responses for transient input signals are obtained from the NEC solution by inverse transforming and convolution. Antennas modified to obtain a linear phase characteristic are seen to be effective in transmitting an input pulse with minimum distortion. The antennas for compressing a linear FM pulse are somewhat effective but do not appear to work as well as might be expected. 5 refs., 19 figs.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 13592, 13882

13260 (LA–12004-C) **Proceedings of the 1990 linear accelerator conference.** Beckmann, C. (comp.). Los Alamos National Lab., NM (USA). Mar 1991. 845p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. (CONF-9009123–: 1990 Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE91009298. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains the papers from the 1990 linear accelerator conference. These papers are processed separately on the data base. (LSP)

4301 Design, Development, and Operation

13261 (BNL–45839) **Upgrading the AGS polarized beam facility.** Ratner, L.G. Brookhaven National Lab., Upton, NY (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9105106–1: 4. conference on the intersections between particle and nuclear physics, Tucson, AZ (USA), 23-29 May 1991). Order Number DE91009466. Source: OSTI; NTIS; INIS; GPO Dep.

Although present techniques for crossing depolarizing resonances in circular accelerators work, they are very time-consuming to implement and were only able to provide about a 40% polarized beam at 22 GeV in the Alternating Gradient Synchrotron (AGS). We propose to install a partial "Siberian Snake" solenoid in the AGS to eliminate the need to correct imperfection resonances and to make other modifications in our intrinsic resonance correctors. This will allow us to reach an energy of 25 GeV with 70% polarization and will enable the AGS to be an efficient injector of polarized protons into the Relativistic Heavy Ion Collider (RHIC), as well as being able to carry on a fixed-target program with minimum set-up time. 3 refs., 5 figs., 1 tab.

13262 (CEA-LNS-Ph–90-46) **Kaon: an advanced hadron facility.** Van Oers, W.T.H. (Laboratoire National Saturne, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR)). Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1990. 26p. (CONF-9007206–: 7. International School of Intermediate Energy Nuclear Physics, L'Aquila (Italy), 16-26 Jul 1990). Order Number DE91757036. Source: OSTI; NTIS (US Sales Only).

An advanced hadron facility KAON has been proposed to be built in Canada. The report of the Project Definition Study has been presented to both levels of Government (federal and provincial) on May 24, 1990, for action in the near future. A short discussion will be given of the scientific motivation. The physics along the intensity and precision frontier is fully complementary to the physics along the energy frontier. Following, a description will be given of the 100 μA, 30 GeV proton synchrotron proposed. The accelerator will consist of five rings using the present 500 MeV cyclotron as an injector. If the project were funded this year, the accelerators would be completed by 1995 or so, with the experimental program starting a year later.

13263 (DOE/ER/40224–184) **Micropole undulator.** Tatchyn, R.O. (Stanford Univ., CA (USA)); Cremer, J.T.; Csonka, P.L. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. 25 Nov 1988. 24p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC03-82ER13000 ;FG06-85ER13309 ;FG06-85ER40224. Grant AFOSR-85-0326. Order Number DE91009619. Source: OSTI; NTIS; INIS; GPO Dep.

Micropole undulators for use in the generation of x-rays from moving charged particles are disclosed. Tow rows of spaced apart poles are arranged so that each pole produces a magnetic field aligned with all other similar fields. The poles are the ends of "C"-shaped magnets. In each row, adjacent poles are separated by spacers made of a superconducting material.

13264 (GANIL-A–9007) **Superconducting booster cyclotron studies at GANIL.** Bieth, C.; Bricault, P.; Chabert, A.; Duval, M.; Ferme, J.; Joubert, A.; Moscatello, M.H.; Ripouteau, F. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 3p. (CONF-900603–: EPAC '90: 2nd European particle accelerator conference ACROPOLIS, Nice (France), 11-16 Jun 1990). Order Number DE91757076. Source: OSTI; NTIS (US Sales Only).

Work is beginning at GANIL on the study of a booster cyclotron SSC3 giving a maximum energy around 500 MeV/A for light ions. SSC3 could be a separated sector cyclotron using superconducting coils. First results concerning these studies are reported.

13265 (LBL–28729) **Coherence, optics and applications of x-ray wavelengths.** Attwood, D. Lawrence Berkeley Lab., CA (USA). Jul 1990. 9p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. F49620-87-K-0001. (CONF-900757–8: X-90: 15th international conference on X-ray and inner-shell processes,

Knoxville, TN (USA), 9-13 Jul 1990). Order Number DE91009739. Source: OSTI; NTIS; GPO Dep.

The extension of coherent optical techniques to the x-ray region of the electromagnetic spectrum opens many new opportunities for science and technology based on very short wavelengths and on photon energies which span the primary atomic resonances of many elements. 14 refs., 5 figs.

13266 (LBL–29232) **Requirements and design of a high stable infrared free electron laser at LBL.** Kim, K.J. (Lawrence Berkeley Lab., CA (USA)); Berz, M.; Chattopadhyay, S.; Gough, R.; Kim, C.; Kung, A.H.; Xie, M.; Edighoffer, J.; Stein, W. Lawrence Berkeley Lab., CA (USA). Jun 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-900603–61: EPAC '90: 2nd European particle accelerator conference ACROPOLIS, Nice (France), 11-16 Jun 1990; ESG–99). Order Number DE91009674. Source: OSTI; NTIS; INIS; GPO Dep.

An infrared free electron laser (IRFEL) is being designed for the Chemical Dynamics Research Laboratory (CDRL) at LBL. The FEL is based on a 50 MeV RF linac operating in synchronization to the Advanced Light Source (ALS), and will produce intense (100 μJ per micropulse), narrow bandwidth (narrower than 0.1%) radiation between 3 μ and 50 μ. In the design, we pay particular attention to the FEL stability issues and require that the fluctuations in electron beam energy and in timing be less than 0.05% and 0.1 ps, respectively. The FEL spectrum can then be stabilized to about 10^{-3}, or if grating is used, to 10^{-4}. We discuss various sources of fluctuations in the gun, the bunchers and the accelerator sections, as well as the feedback and feedforward schemes to reduce these fluctuations. The accelerator structure is chosen to be of the side coupled, standing wave type for easier control. The beam transport is made isochronous to avoid the coupling between the energy and the timing fluctuations. 9 refs., 2 figs.

13267 (LBL–29957) **Design overview of a highly stable infrared free electron laser at LBL.** Kim, K.J. (Lawrence Berkeley Lab., CA (USA)); Berz, M.; Chattopadhyay, S.; Gough, R.; Kim, C.; Kung, A.H.; Xie, M.; Edighoffer, J.; Stein, W. Lawrence Berkeley Lab., CA (USA). Nov 1990. 13p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9009166–20: 12. international free electron laser conference (FEL-12), Paris (France), 17-21 Sep 1990; ESG–112). Order Number DE91009327. Source: OSTI; NTIS; INIS; GPO Dep.

An infrared free electron laser (IRFEL) is being designed for the Chemical Dynamics Research Laboratory (CDRL) at LBL. The FEL is based on a 50 MeV RF linac operating in synchronization to the Advanced Light Source (ALS), and will produce intense (100 μJ per micropulse), narrow bandwidth (narrower than 0.1%) radiation between 3 μ and 50 μ. In the design, we pay particular attention to the FEL stability issues and require that the fluctuations in electron beam energy and in timing be less then 0.05% and 0.1 ps respectively. The FEL spectrum can then be stabilized to about 10^{-3}, or if grating is used, to 10^{-4}. We discuss various sources of fluctuations in the gun, the bunchers and the accelerator sections, as well as the feedback and feedforward schemes to reduce these fluctuations. The accelerator structure is chosen to be of the side coupled, standing wave type for easier control. The beam transport is made isochronous to avoid the coupling between the energy and the timing fluctuations. 12 refs., 1 fig.

13268 (LBL-PUB–496-No.6) **Bevalac operations update.** Lawrence Berkeley Lab., CA (USA). Feb 1991. 20p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. Order Number DE91009077. Source: OSTI; NTIS; INIS; GPO Dep.

The Bevalac passed the recent Tiger Team assessment with flying colors, thanks to the unremitting effort of countless people over the last several months, pulling miles of cables, sending tons of "valuable" junk to salvage, painting, pushing brooms, writing operating procedures. It is time to look ahead now and plan for doing science again; however, it is not business as usual. The Bevalac survived, but not without changes. There are more procedures to be followed, safety appraisals to be made, training to be gone through. The primary goal is not just to get a task done, but to get it done in a safe manner according to code. If this means a delay in a run because enough time wasn't allotted for making a change in the setup, then the experiment will be delayed. Many of the obvious changes you will find the next time you come to work here are summarized in this newsletter. We will inform you of others as they are forthcoming. Also we will discuss these changes at our "We Survived the Tigers, but···" Users' Information Meeting at the Washington APS meeting. Details are inside this report.

13269 (SLAC-PUB–5347) **New acceleration schemes and technologies.** Palmer, R.B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515. (CONF-9010271–3: International seminar on future perspectives in HEP, Protvino (USSR), 6-8 Oct 1990). Order Number DE91009361. Source: QSTI; NTIS; INIS; GPO Dep.

The search for new acceleration schemes and technologies has in general, been restricted to a search for higher gradient acceleration, and it has been motivated by the aim of reducing the length, and presumably the cost, of new high energy facilities. In particular, it has been argued that very high energy linear colliders will only be practical if much higher acceleration gradients are employed. This report investigates possible higher acceleration gradient and beam luminosity problems.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 13261, 13298, 13299, 13853

13270 (DESY-M–90-13) **A contribution to the numerical calculation of static electromagnetic fields in unbounded domains.** Krawczyk, F. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich 12 - Physik. Nov 1990. 87p. Order Number DE91756671. Source: OSTI; NTIS (US Sales Only); INIS.

The numerical calculation of static electromagnetic fields for arbitrarily shaped three-dimensional structures, especially in unbounded domains, is very memory and cpu-time consuming. In this thesis several schemes that reduce memory and cpu-time consumption have been developed or introduced. The memory needed can be reduced by a special simulation of boundaries towards open space and by the use of a scalar potential for the field description. Known disadvantages of the use of such a potential are avoided by an improved formulation of the used algorithms. The cpu-time for the calculations can be reduced remarkably in many cases by using a multigrid solution scheme including a defect-correction. A computer code has been written that uses these algorithms. With the help of this program it has been demonstrated that using these algorithms, distinct improvements in terms of computer memory, cpu-time consumption and accuracy can be achieved. (orig.).

13271 (FNAL/C–90/250) **Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams.** Gerasimov, A. Fermi National Accelerator Lab., Batavia, IL (USA). 6 Dec 1990. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-910505–1: Particle accelerator conference, San Francisco, CA (USA), 6-9 May 1991). Order Number DE91006379. Source: OSTI; NTIS; INIS; GPO Dep.

The escape rates and evolution of a distribution of particles are considered for a 2-D model of transverse motion of particles in hadronic storage rings, when nonlinear resonances and external diffusion are present. Dynamic enhancement of diffusion inside separatrices can develop under a certain geometry of resonance oscillations and relatively wide resonances, leading to the fast growth of distribution tails and escape rates. The phenomenon is absent in 1-D. 10 refs., 4 figs.

13272 (FNAL/C–91/39) **The Fermilab Linac Upgrade.** Noble, R.J. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9009123–69: 1990 Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE91009457. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermilab Linac Upgrade is planned to increase the energy of the H- linac from 200 to 400 MeV. This is intended to reduce the incoherent space-charge tuneshift at injection into the 8 GeV

Booster which can limit either the brightness or the total intensity of the beam. The Linac Upgrade will be achieved by replacing the last four 201.25 MHz drift-tube tanks which accelerate the beam from 116 to 200 MeV, with seven 805 MHz side-coupled cavity modules operating at an average axial field of abut 7.5 MV/m. This will allow acceleration to 400 MeV in the existing Linac enclosure. Each accelerator module will be driven with a klystron-based rf power supply. A prototype rf modulator has been built and tested at Fermilab, and a prototype 12 MW klystron is being fabricated by Litton Electron Devices. Fabrication of production accelerator modules is in progress. 8 figs., 4 tabs.

13273 (FNAL-TM–1716) **An ESME update (v. 7.2).** MacLachlan, J.A. Fermi National Accelerator Lab., Batavia, IL (USA). 11 Feb 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. Order Number DE91009358. Source: OSTI; NTIS; GPO Dep.

The program ESME for modeling the longitudinal degree of freedom of beam dynamics in proton synchrotrons was described in considerable detail in "User's Guide to ESME v. 7.1" distributed about a year ago. This note corrects minor errors and omissions in the User's Guide, discusses bugs and crochets, notes fixes, and reports a few enhancements. Current work and plans are sketched. This note should be adequate to update the User's Guide. 8 refs.

13274 (LBL–29233) **Study of a "relaxed" ALS storage ring lattice.** Keller, R.; Forest, E.; Nishimura, H.; Zisman, M.S. Lawrence Berkeley Lab., CA (USA). Jun 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-900603–60: EPAC '90: 2nd European particle accelerator conference ACROPOLIS, Nice (France), 11-16 Jun 1990; ESG–100). Order Number DE91009740. Source: OSTI; NTIS; INIS; GPO Dep.

The lattice of the Advanced Light Source (ALS) 1–1.9 GeV electron storage ring was reexamined, introducing an additional family of focusing quadrupoles and looking for a working point with larger dynamic aperture. In the first part of this study, the ideal lattice was investigated to confirm the anticipated behavior, and indeed conditions with increased dynamic aperture were found. In the second part, realistic magnet errors and an undulator in one of the straight sections were taken into account. Under these conditions the dynamic aperture could not be significantly improved over the nominal configuration. Further studies included investigation of the Touschek momentum acceptance of the lattice. In this case too, no net benefit was obtained from the additional quadrupoles. 6 refs., 5 figs. , 2 tabs.

13275 (SLAC-ABC–24) **Simulation of longitudinal coupled-bunch instabilities.** Thompson, K.A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 7 Feb 1991. 9p. Sponsored by USDOE,. DOE Contract AC03-76SF00515. Order Number DE91008536. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this note is to document some work done as part of the effort directed at designing and simulating a bunch-by-bunch feedback system to control longitudinal coupled bunch instabilities in the B-factory. In particular, I discuss the ring model used in the simulation program developed to study this feedback system. Basically the simulation is a simple tracking program in which the rf drive voltage, the wakefields due to all the bunches, the synchrotron radiation losses, and the kicks applied to the bunches by the bunch-by-bunch feedback are all modelled as voltages applied at a single, discrete point in the ring. The computation of the bunch-by-bunch feedback voltages may of course be done by any desired algorithms. An example and discussion of the general behavior without bunch-by-bunch feedback is given at the end of this report.

13276 (SLAC-PUB–5436) **Collimation systems in the next linear collider.** Merminga, N.; Irwin, J.; Helm, R.; Ruth, R.D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515. (CONF-9006267–26: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91009367. Source: OSTI; NTIS; INIS; GPO Dep.

Experience indicates that beam collimation will be an essential element of the next generation e^+E^- linear colliders. A proposal for using nonlinear lenses to drive beam tails to large amplitudes was presented in a previous paper. Here we study the optimization of such systems including effects of wakefields and optical aberrations. Protection and design of the scrapers in these systems are discussed. 9 refs., 7 figs.

4303 Auxiliaries and Components

Refer also to citation(s) 13183, 13276, 13317, 13319, 13330, 13336, 13698, 13848, 13856

13277 (ANL/CP–70732) **The Pulsed Neutron Research Facility: Proposal for a mid-scale installation at Argonne National Laboratory.** Brown, B.S.; Carpenter, J.M.; Kustom, R.L. Argonne National Lab., IL (USA). [1990]. 12p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-9006235–2: 114. enrico fermi school of physics, La Specia (Italy), 19-29 Jun 1990). Order Number DE91008810. Source: OSTI; NTIS; INIS; GPO Dep.

We describe a proposal for a mid-scale pulsed spallation neutron source for neutron scattering research, based on a Fixed-Field Alternating-Gradient proton synchrotron.

13278 (BONN-IR–90-35) **Tracking of charged particles in the holding field of the frozen-spin target.** Reicherz, G. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1990. 51p. (In German). Order Number DE91756663. Source: OSTI; NTIS (US Sales Only); INIS.

Scattering experiments with the new 'bonn frozen spin target' (BOFROST) are planned at ELSA with the PHOENICS-detector. The magnet system of BOFROST consists of two superconducting solenoids: a polarization magnet and a 'vertical holding' magnet. The maximum field of the 'vertical holding' magnet in the target area is 0.57 T with a coil current of 200A. This work describes the measurement of the external field of the 'vertical holding' magnet at 0.35, 0.45, and 0.57 Tesla. The trace-tracking of charged particles combining BOFROST with the PHOENICS-detector was performed. (orig.).

13279 (BONN-IR–90-36) **Correction of the equilibrium orbit at the Bonn 3.5 GeV electron stretcher facility ELSA.** Wenzel, J. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Sep 1990. 57p. (In German). Order Number DE91756617. Source: OSTI; NTIS (US Sales Only); INIS.

A beam position monitor system is being built for the Bonn electron stretcher facility ELSA. Based on the ELSA monitor system the Closed Orbit Correction Program for Interactive Tasks COCPIT has been developed. It enables an online correction of the closed orbit and is fully integrated into the ELSA operating system which allows control of all steering and diagnostic facilities of ELSA. COCPIT implements least square and harmonic correction methods with choosable harmonic components. A statistical analysis shows which correction method is best under given circumstances. Furthermore data about the current status of the monitor system as well as the corrector system enter the correction. Monitor offsets are added to the position measurements and the corrector-dipoles maximum currents are accounted for as constraints. Computer simulations prove the proper work of COCPIT and the validity of the statistical analysis. Possibilities of a future development of COCPIT are shown. (orig.).

13280 (BONN-IR–90-44) **Construction, test, and operation of an energy-tagged photon beam at the PHOENICS experiment of the Bonn electron stretcher facility ELSA.** Detemple, P. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 56p. (In German). Order Number DE91756660. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the photon tagging facility of the PHOENICS-Experiment at the Bonn Electron Stretcher and Accelerator ELSA. The system is designed for primary electron energies up to E_0 = 1.2 GeV and covers a broad energy range k/E_0 = 20-95% simultaneously with an average energy resolution $\Delta k/E_0$=7.5%. The tagging spectrometer consists of a single dipole magnet with a strong radial field gradient, which provides focussing

properties in the deflection plane over a wide energy range. The tagging hodoscope consists of an array of 128 thin energy defining scintillation counters and an additional set of 16 thick backing counters for improved timing resolution and background rejection. The main properties were determined experimentally. The spot size of the primary electron beam at the radiator is $\simeq$ 1 mm (σ), the photon beam spot size at a distance of 2 m from the radiator is $\simeq$ 2 mm. The average tagging efficiency, measured with a total absorbing NaI-detector, is about 90%. The mean photon energies corresponding to the 128 energy defining counters were experimentally determined and found to be in good agreement with the design values. The tagging system has been used in a first experiment with the PHOENICS-Detector, the measurement of the differential cross section for the reaction $\gamma p \rightarrow \pi^+ n$, which was performed in order to test and calibrate the whole detector system. The data shows good agreement with other experiments. (orig.).

13281 (BONN-IR–90-48) **A polarized target for measurements at the external electron beam.** Thomas, A. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 45p. (In German). Order Number DE91756661. Source: OSTI; NTIS (US Sales Only); INIS.

Electron scattering experiments to measure neutron and deuteron formfactors with the new 'Bonn POlarized ELAN Target' (POET) are planned at ELSA in combination with the ELAN detector. The magnet system of POET consists of a superconducting split-pair magnet with a maximum field of 4 Tesla. The target volume of 15 cm^3 is cooled in a vertical $^3He/^4He$ dilution refrigerator with a lowest temperature of 50 mK. This work describes the components and the first tests of POET, especially the determination of the cooling power of the dilution refrigerator. First polarization measurements using ammonia $^{15}NH_3$ as target material were performed. The maximum polarizations were P=+94% and P=90%. (orig.).

13282 (CEA-CONF–10422) **Status of the η project at Saturne.** Mayer, B. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire. 1990. 8p. (CONF-9003177–: International workshop on rare decays of light mesons, Gif-sur-Yvette (France), 29-30 Mar 1990). Order Number DE91752704. Source: OSTI; NTIS (US Sales Only).

An η factory has been installed at Saclay. The η are produced by the $pd \rightarrow {}^3He\eta$ reaction near threshold and tagged by the detection of ^3He in a magnetic spectrometer. The rate of tagged η is 10^5/s. Rare decays of the η meson will be investigated, beginning with $\eta \rightarrow \mu^+\mu^-$ where the μ will be detected in range telescopes. Magnetic spectrometers for lepton detection are considered for future experiments.

13283 (DOE/ER/40224–134) **[Theory of elementary particles studies in weak interaction and grand unification and studies in accelerator design]: Annual report, Task B.** Oregon Univ., Eugene, OR (USA). [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. Order Number DE91009588. Source: OSTI; NTIS; INIS; GPO Dep.

We have continued to explore the capabilities of micropole undulators. These devices were originally proposed by us, and after the first prototypes were built, their performance confirmed theoretical expectations. This report discusses some possible applications.

13284 (FNAL/C–91/38) **Review of negative hydrogen ion sources.** Schmidt, C.W. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9009123–66: 1990 Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE91009461. Source: OSTI; NTIS; INIS; GPO Dep.

In the early seventies, significant discoveries for H^- ion sources were made at Novosibirsk. These and many improvements which followed have led to useful accelerator sources. With these sources charge-exchange injection into circular accelerators has become desirable and routine. This paper reviews the major developments leading to practical H^- sources. Different types and variations of these sources with some basic physics and operation will be described. The operating parameters and beam characteristics of these sources will be given. 32 refs., 13 figs.

13285 (FNAL/C–91/44) **Diagnostics for the 400 MeV FNAL Linac.** McCrory, E.S.; Lee, G. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9009123–68: 1990 Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE91009456. Source: OSTI; NTIS; INIS; GPO Dep.

The last four 201 MHz alvarez tanks of the twenty-year-old, 200 MeV Fermilab Linac are being replaced by seven high-gradient (7 KV/m), high-frequency (805 MHz) side-coupled-cavity structures to produce a 400 MeV beam for injection into the Booster. Good, reliable beam diagnostics are an important factor in the success of this project. This paper discusses the diagnostic systems.

13286 (FNAL/C–91/47) **Conditioning of high gradient H^- accelerating cavities.** Kroc, T.; Moretti, A. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9009123–67: 1990 Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE91009454. Source: OSTI; NTIS; INIS; GPO Dep.

Three prototype cavities for the side-coupled accelerating structure of Fermilab's Linac Upgrade have been powered. The cavities operate at a nominal maximum surface electric field of 37–42 MV/m and have been run at close to 60 MV/m at 805 MHz. This paper will present the experience accumulated on x-ray production and RF breakdown frequency. We will try to compare our data with others' experiences with high surface electric fields. 5 refs., 3 figs.

13287 (FNAL-TM–1708) **Multiple gas analyzer sample test points.** Sellberg, G. Fermi National Accelerator Lab., Batavia, IL (USA). 21 Oct 1988. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. Order Number DE91009359. Source: OSTI; NTIS; GPO Dep.

Fermi National Accelerator Laboratory (Fermilab) is now beginning to depend upon dedicated gas analyzers in their collider and large fixed target experiment areas. In the past one or two gas samples were taken and sent off to Argonne National Laboratory for gas analysis, for even a basic check of ratios for Ar (Argon) C_2H_6 (Ethane) 50/50% mixtures. This paper discusses the measuring techniques.

13288 (FNAL-TM–1719) **Procedures for application of Don Cossairt's CASIM calculations in TM-1140 to bulk shielding.** Garbincius, P.H. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. Order Number DE91009357. Source: OSTI; NTIS; GPO Dep.

As part of the methodology documentation for the site-wide radiation shielding assessment, these two related notes were written showing how to apply the CASIM calculations of TM-1140 to determine required shielding for various beam intensities and steel-soil composites. These notes have been reviewed by the Fermilab ES&H Section and approved for use in evaluating shielding requirements.

13289 (GANIL-A–9004) **Status of the new high intensity injection system for GANIL.** Ricaud, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Attal, P.; Baron, E.; Bony, J.; Bourgarel, M.P.; Bru, B.; Chabert, A.; Daudin, F.; Ozille, M.; Sortais, P.; Chel, S.; Vienet, R. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 3 pp. (CONF-900603–: EPAC '90: 2nd European particle accelerator conference ACROPOLIS, Nice (France), 11-16 Jun 1990). Order Number DE91757078. Source: OSTI; NTIS (US Sales Only).

The design and construction of a new high intensity injection system at GANIL is under way; the goals are to accelerate several tens of electrical microamperes of Ar and Kr ions (mainly to produce exotic nuclei) and to increase the heaviest ion beam intensities (Pb, U). A factor of 2 to 3 will be obtained by raising the ECRIS frequency 10 to 14.5 GHz and another factor of 2 is expected from the new design of the axial injection line of one of the two compact cyclotrons (the capture of 40% of the beam in a $\pm 6^0$ phase width is foreseen). A description is given of the source and its associated elements installed on a 100 kV insulated platform,

along with the axial injection line and the central geometry of the injector cyclotron.

13290 (GANIL-A–9005) **First results of the 14.5 GHz Ganil ECR source with the C.W. and the pulsed operation mode.** Bourgarel, M.P.; Sortais, P.; Attal, P.; Bisch, M.; Cornen, P.M.; Leherissier, P.; Pacquet, J.Y.; Rataud, J.P.; Schmiechen, G. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 2p. (CONF-900603–: EPAC '90: 2nd European particle accelerator conference ACROPOLIS, Nice (France), 11-16 Jun 1990). Order Number DE91757077. Source: OSTI; NTIS (US Sales Only).

A 14.5 GHz ECR source has been designed and built at GANIL in order to improve the currents, mainly the heaviest ion beam intensities (Pb, U). We give the first results obtained with the C.W operation used on the cyclotron machines, and those we can get with the pulsed operation mode which concerns Linacs and other machines.

13291 (INS-T–498, pp. 17-19) **The construction of the internal gas jet (polarized) target and the study of energy dependent phenomena of nuclear reactions.** Hasegawa, Takeo (Miyazaki Univ. (Japan). Faculty of Engineering). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of the internal gas jet (polarized) target in the TARN-II ring is proposed to measure the energy dependent phenomena of nuclear reactions in the intermediate energy region. (author).

13292 (INS-T–498, pp. 56-62) **Computer control system of TARN-II.** Watanabe, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the present status and future plane of TARN-II computer control system. At present, the microcomputer M-16 is used as the main control computer to regulate the 64 kinds of power supplies coupled with the serial CAMAC interface system. An excitation control of the main ring magnets is performed with the aid of self-learn technique to optimize the tracking error among them. An Rf pattern control is also performed with the microcomputer as well as the main ring control system. New computer system linked with the Ethernet is planed to develop the computing power and portability of the present control system. (author).

13293 (INS-T–498, pp. 63-67) **Slow beam extraction.** Noda, Akira (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

A slow beam extraction system of TARN II with use of a third order resonance is constructed mainly oriented for biomedical irradiation with heavy ions (p, $\alpha \approx$Ne) of intermediate energies (150$\approx$350 MeV/u). All the hardware equipments for the extraction have already been completed including requirement for ultra-high vacuum. Beam tracking based on a transfer matrix formalism has been performed. The effect of the non-linear element is taken into account with a thin lens approximation. With the code, the effect of the current ripple in the power supplies of quadrupole magnets are studied and it is found that ripples larger than 10^{-3} have a serious effect on the beam spill. (author).

13294 (INS-T–498, pp. 68-71) **Development of 25.5 MHz Split Coaxial RFQ.** Tokuda, Noboru (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

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13295 (INS-T–498, pp. 1-7) **Present status of TARN 2 project.** Katayama, Takeshi (Tokyo Univ. (Japan). Inst. for Nuclear Study). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

As the facility for further developing the results of research at TARN and carrying out the research on the development of a synthetic accelerator as a cooler synchrotron, the TARN 2 was constructed. The progress and present status of the project are described, and the plan on a number of the modes of future development is shown. For the research on heavy ion beam and the development of a heavy ion linear accelerator, the test accumulation ring for Numatron (TARN) and the TALL were constructed. TARN was disassembled, and the TARN 2 began the experiment in early 1989. Multiple injection, the electron beam cooling experiment using proton beam and the synchrotron acceleration of proton beam and alpha beam were successfully accomplished, in this way, the initial targets of research of the TARN 2 were almost attained. The experiment on taking out slow beam is started in the autumn of 1990, and the basic research on the development of an accelerator for a cooler synchrotron centering around the electron cooling of ion beam can mark one stage within fiscal year 1990. The results of research at the TARN 2 have been published in many international conferences. The state of progress of researches up to now and the future perspective are reported. (K.I.).

13296 (INS-T–498, pp. 72-80) **Prof. Ikegami's speculation on magnetized electron cooling.** Ando, Ainosuke (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Electron cooling has been established as a very effective technique to form high-performance, high-resolution low-energy beam, and many practical processes are available for the technique. In the present report, the feasibility of fast cooling at a drastically increased speed, hence the feasibility of fast cooling of high-energy beam, achievement of high brightness and improvement in the yield of secondary cooled beam, are discussed based on the quantum mechanical study of the elemental processes of electron cooling made by Dr. Ikegami. Electron cooling consists of the Coulomb scattering of ions and electrons. For increased cooling performance, a uniform solenoidal magnetic field is applied to them so that the transverse thermal movements of the electrons are pinned to eliminate their contribution to the cooling process. These electrons, with their transverse kinetic state quantized, are then distributed over the Landau orbit. The application of light of a certain frequency (RF) suited for inducing the transition between the Landau orbits must stimulate the transfer of "real photons" with a certain energy (1st step, stimulated Coulomb Scattering). If the beam is controlled properly, it should be possible to achieve direct cooling of all the charged particles (2nd step, cyclotron maser cooling). The first step can be regarded as Coulomb scattering ions by electrons actively moving between the Landau orbits, hence the concept of magnetized electron cooling assisted with radiation (3rd step). (N.K.).

13297 (INS-T–498, pp. 81-88) **Physics in RCNP cooler synchrotron.** Fujiwara, Mamoru (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

In the Research Center for Nuclear Physics, Osaka University, a ring cyclotron beam transmission system and a large scale experimental facility are under construction as the four-year project from 1987. The existing AVF cyclotron of K=120 MeV is utilized as the injector. The beam injected into the ring cyclotron of K=400 MeV is accelerated to further high energy. There are three independent laboratories, and the preparation of experimental equipment is carried out. In the east laboratory, a secondary beam course is constructed, and one more beam course is planned. The project of constructing a pi-meson spectrometer in near future is proposed. In the neutron laboratory, a beam swinger is installed, and the experiment on time of flight using a tunnel of 100 m length is carried out. The west laboratory is a large laboratory, in which the reaction charged particle spectrograph having the highest resolution in the world "Grand Raiden" is installed. The preparation for constructing a cooler synchrotron in future is made. In April, 1991, the four-year project will be completed. The joint experiment can be done in the first half of 1992. As the physics expected when a cooler synchrotron will be completed, a number of the examples are shown. (K.I.).

13298 (LA-UR–91-532) **Advanced, time-resolved imaging techniques for electron-beam characterizations.** Lumpkin, A.H. Los Alamos National Lab., NM (USA). [1990]. 54p. Sponsored by U.S. DOE Contract W-7405-ENG-36. (CONF-9010267–3: 1990 workshop on accelerator instrumentation, Batavia, IL (USA), 1-4 Oct 1990). Order Number DE91008587. Source: OSTI; NTIS; GPO Dep.

Several unique time-resolved imaging techniques have been developed to address radio frequency (RF)-linac generated electron beams and the free-electron lasers (FEL) driven by such systems. The time structures of these beams involve a series of micropulses with 10 to 15-ps duration, separated by tens of nanoseconds. Mechanisms to convert the e-beam information to optical radiation include optical transition radiation (OTR), Cherenkov radiation, spontaneous emission radiation (SER), and the FEL mechanism itself. The use of gated, intensified television cameras and synchroscan and dual-sweep streak cameras to time-resolve these signals has greatly enhanced the power of these techniques. A brief review of the less familiar conversion mechanisms and electro-optic techniques is followed by a series of specific experimental examples from the RF linac FEL facilities at Los Alamos and Boeing (Seattle, WA). 23 refs., 35 figs., 3 tabs.

13299 (LBL–29622) **Double rf system for bunch shortening.** Chin, Yong Ho. Lawrence Berkeley Lab., CA (USA). Nov 1990. 20p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9010276–3: International workshop on accelerators for asymmetric B-factories, Tsukuba (Japan), 4-6 Oct 1990). Order Number DE91009094. Source: OSTI; NTIS; INIS; GPO Dep.

It was suggested by Zisman that the combination of the two systems (double rf system) may be more effective to shorten a bunch, compromising between the desirable and the undesirable effects mentioned above. In this paper, we demonstrate that a double rf system is, in fact, quite effective in optimizing the rf performance. The parameters used are explained, and some handy formulae for bunch parameters are derived. We consider an example of bunch shortening by adding a higher-harmonic rf system to the main rf system. The parameters of the main rf system are unchanged. The double rf system, however, can be used for another purpose. Namely, the original bunch length can be obtained with a main rf voltage substantially lower than for a single rf system without necessitating a high-power source for the higher-harmonic cavities. Using a double rf system, the momentum acceptance remains large enough for ample beam lifetime. Moreover, the increase in nonlinearity of the rf waveform increases the synchrotron tune spread, which potentially helps a beam to be stabilized against longitudinal coupled-bunch instabilities. We will show some examples of this application. We discuss the choice of the higher-harmonic frequency.

13300 (LBL–29822) **ALS insertion devices.** Hoyer, E.; Chin, J.; Halbach, K.; Hassenzahl, W.V.; Humphries, D.; Kincaid, B.; Lancaster, H.; Plate, D. Lawrence Berkeley Lab., CA (USA). Nov 1990. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-901144–2: Vacuum design of advanced synchrotron light sources, Argonne, IL (USA), 13-15 Nov 1990). Order Number DE91009081. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS), the first US third generation synchrotron radiation source, is currently under construction at the Lawrence Berkeley Laboratory. The low-emittance, 1.5 GeV electron storage ring and the insertion devices are specifically designed to produce high brightness beams in the UV to soft X-Ray range. The planned initial complement of insertion devices includes four 4.6 m long undulators, with period lengths of 3.9 cm, 5.0 cm (2) and 8.0 cm, and a 2.9 m long wiggler of 16 cm period length. Undulator design is well advanced and fabrication has begun on the 5.0 cm and 8.0 cm period length undulators. This paper discusses ALS insertion device requirements; general design philosophy; and design of the magnetic structure, support structure/drive systems, control system and vacuum system. 18 refs., 9 figs., 5 tabs.

4304 Storage Rings

Refer also to citation(s) 13274, 13291, 13292, 13293, 13671

13301 (INS-T–498, pp. 20-22) **Laser spectroscopy in storage ring.** Matsuki, S. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Laser spectroscopy with a storage ring will bring many fruitful results on nuclear, atomic and related physics; laser cooling of a fast ion beam in addition to the electron cooling is essential for opening a new field in these physics. In this talk, new development and future prospect of laser cooling scheme of a fast ion beam in a storage ring is briefly reviewed. (author).

13302 (INS-T–498, pp. 89-94) **Synchrotron ring as a multi-turn time-of-flight mass spectrometer.** Fujita, Yoshitaka (Osaka Univ., Toyonaka (Japan). Coll. of General Education); Takahashi, Noriaki; Schwab, T. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

It is proposed that a synchrotron ring can be used as a time-of-flight mass spectrometer. Either of the following two conditions has to be realized; (a) the ring is tuned so as to achieve an isochronous condition for particles circulating in it, (b) all the particles in the ring are cooled down to have a extremely small momentum spread. The synchrotron ring used as a time-of-flight mass spectrometer is suited for the on-line mass measurement of short-lived nuclei which are produced at an upstream production target before the injection into the ring. (author).

13303 (LBL–29823) **Manufacture of the ALS storage ring vacuum system.** Kennedy, K. Lawrence Berkeley Lab., CA (USA). Nov 1990. 6p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-901144–3: Vacuum design of advanced synchrotron light sources, Argonne, IL (USA), 13-15 Nov 1990). Order Number DE91009073. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS) storage rings has a 4.9 meter magnetic radius and an antechamber type vacuum chamber. These two requirements makes conventional bent tube manufacturing techniques difficult. The ALS sector vacuum chambers have been made by matching two halves out of aluminum plate and welding at the mid plane. Each of these chambers have over 50 penetrations with metal sealed flanges and seven metal sealed poppet valves which use the chamber wall as the valve seat. The sector chambers are 10 meter long and some features in the chambers must be located to .25 mm. This paper describes how and how successfully these features have been achieved. 2 refs., 5 figs.

13304 (LPNHEP–9002) **A fastbus master based on a risc microprocessor.** Cerrito, L.; Chorowicz, V.; Lebbolo, H.; Vallereau, A. Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies. Jan 1990. 23p. Order Number DE91752703. Source: OSTI; NTIS (US Sales Only).

SISIFUS is a general purpose Fastbus Master and Slave able to perform any operation on both Fastbus segments. Master operations are directed either by the processor or by two fast sequencers. A Block Mover function is implemented allowing direct data block transfers between two Slaves. SISIFUS uses the AM 29000 RISC microprocessor which can execute every assembler instruction in 40ns. The on-board monitor/debugger allows programs to be written in assembler from a terminal connected to the module or written in C and cross compiled on a host computer (PC).

44 INSTRUMENTATION

Refer also to citation(s) 13921

13305 (CEA-R-5536) **Semi-transparent X-UV multilayer: theoretical analysis, characterisation and applications.** Susini, J. CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France); Paris-6 Univ., 75 (France). Mar 1989. 276p. (In French). Order Number DE91752734. Source: OSTI; NTIS (US Sales Only).

This work presents a study of semi-transparent X-UV multilayers. These were fabricated by local destruction of a substrate or by multilayer deposition on a low absorbance thin film. From these multilayers an X-Ray beamsplitter can be made which has a good transmission coefficient and a large relection coefficient. The compromise between transmittance and reflectance can be optimized by choosing adequate parameters for both the multilayer and the substrate. This can be done using calculation methods developed for X-UV interferential mirrors. An experimental apparatus called multilayers bichromator was then developed. It is based on the semi-transparent multilayer properties. This made possible the study of the time shift between two neon plasma emission lines in the one KeV range.

4401 Radiation Instrumentation

Refer also to citation(s) 12528, 12553, 12572, 12755, 13120, 13280, 13629, 13631, 13639, 13673, 13745, 13747, 13775, 13913

13306 (ANL/CP-71633) **Large aperture CCD x-ray detector for protein crystallography using a fiberoptic taper.** Strauss, M.G. (Argonne National Lab., IL (USA)); Westbrook, E.M.; Naday, I.; Coleman, T.A.; Westbrook, M.L.; Travis, D.J.; Sweet, R.M.; Pflugrath, J.W.; Stanton, M. Argonne National Lab., IL (USA). [1991]. 16p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-910294-1: Society of Photo-optical Instrumentation Engineers (SPIE) symposium on electronic imaging science and technology, San Jose, CA (USA), 25 Feb - 1 mar 1991). Order Number DE91008832. Source: OSTI; NTIS; GPO Dep.

A detector with a 114 mm aperture, based on a charge-coupled device (CCD), has been designed for x-ray diffraction studies in protein crystallography. The detector was tested on a beamline of the National Synchrotron Light Source at Brookhaven National Laboratory with a beam intensity greater than 10^9 x-ray photons/s. A fiberoptic taper, an image intensifier and a lens demagnify, intensify, and focus the image onto a CCD having 512 x 512 pixels. A detective quantum efficiency (DOE) of 0.36 was obtained by evaluating the statistical uncertainty in the detector output. The dynamic range of a 4 x 4 pixel resolution element, comparable in size to a diffraction peak, was 10^4. The point-spread function shows FWHM resolution of approximately 1 pixel, where a pixel on the detector face is 160 μm. A complete data set, consisting of forty-five 1° rotation frames, was obtained in just 36 s of x-ray exposure to a crystal of chicken egg-white lysozyme. In a separate experiment, a lysozyme data set consisting of 495 0.1° frames, was processed by the MADNES data reduction program, yielding symmetry R-factors for the data of 3.2–3.5%. Diffraction images from crystals of the myosin S1 head (a = 275 Å) were also recorded. The Bragg spots, only 5 pixels apart, were resolved but were not sufficiently separated to process these data. Changes in the detector design which will improve the DQE and spatial resolution are outlined. The overall performance showed that this type of detector is well suited for x-ray scattering investigations with synchrotron sources. 23 refs., 11 figs.

13307 (BNL-45416) **Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers.** Tsang, T. (Brookhaven National Lab., Upton, NY (USA)); Radeka, V.; Srinivasan-Rao, T.; Willis, W.J. Brookhaven National Lab., Upton, NY (USA). Nov 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910595-6: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91008439. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the preliminary measurements of the optical power requirement, linearity, dynamic range, and noise characteristics of a Mach-Zehnder electro-optical modulator will be presented. The modulator system will be used to minimize the local electronics on a large scale particle detector. 3 refs., 3 figs.

13308 (BNL-45840) **Liquid argon calorimetry for the SSC.** Gordon, H.A. Brookhaven National Lab., Upton, NY (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9010212-38: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91009467. Source: OSTI; NTIS; INIS; GPO Dep.

Liquid argon calorimetry is a mature technique. However, adapting it to the challenging environment of the SSC requires a large amount of R & D. The advantages of the liquid argon approach are summarized and the issues being addressed by the R & D program are described. 18 refs.

13309 (BNL-45841) **Two-arm electron/photon spectrometer collaboration.** Hayano, R.S. (Tokyo Univ. (Japan)); Sakurai, H.; Akiba, Y.; Hamagaki, H.; Tanaka, Y.; Chiba, J.; En'yo, H.; Sano, H.; Sugitate, T.; Hayashi, S.; Tanaka, M.; Tannenbaum, M.J. Brookhaven National Lab., Upton, NY (USA). [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-900772-10: 4. workshop on experiments and detectors for a relativistic heavy ion collider, Upton, NY (USA), 2-7 Jul 1990). Order Number DE91009438. Source: OSTI; NTIS; INIS; GPO Dep.

The main focus of this working group was to design a detector system which is capable of measuring soft low-mass e^+e^- pair ($M_{e^+e^-}$) production from ~4 GeV/c^2 down to a few hundred MeV/c^2 in the central rapidity region, together with associated hadron charged multiplicity and transverse neutral energy of the event. The soft dilepton production in this mass range and direct photon production are expected to be a sensitive penetrating probe to study the properties of the high energy density matter (hot hadron gas, mixed phase, and QGP) created in the heavy-ion collisions at RHIC. The measurement of low-mass e^+e^- pair production with low p_T, is a nontrivial task due to the overwhelmingly large combinatorial background from π^0 and η Dalitz decays. The key to the successful measurement of the low-mass continuum is to effectively reject Dalitz-decay pairs. This requires an identification of e^+e^- pairs with relatively small ($\theta < 10°$) opening angles before they enter a magnetic volume. The detector system we studied during the workshop is described. It has two identical arms on both sides of the beam pipe (each covering $-0.2 < \eta < 0.2$, $-20° < \phi < 45°$), has a gas ring-imaging Cerenkov (RICH) counter on each arm. The RICH counters are placed close to the beam pipe, in a field-free region, and are used to identify electrons and to reject small-region e^+e^- pairs.

13310 (BONN-IR-90-28) **Studies and developments on the track recognition in the forward drift chambers of the ZEUS detector.** Schattevoy, R. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Jul 1990. 168p. (In German). Order Number DE91756462. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of this paper we have investigated two independent problems: The first part describes the simulation of the planar drift chambers of the ZEUS detector (FTD and RTD). We have spent particular effort to obtain a realistic and manageable description of the space-to-drifttime-relation (SDR). Our solution exhibits a functional dependence on angles and distances being close enough to reality in order to study the problems in track finding and trigger algorithms. Moreover we discuss the deviations of

our approximation from the 'correct' SDR. In the second part we investigate suitable methods for the reconstruction of tracks in these detector component. We show that the existing ambiguities, mutually dependent on each other, can be resolved by an iterative procedure of two programme units: the first one consists of building track elements in one projection while the second unit links these projections to form a track element in space. We present three different methods for linking the projections and discuss their application in different areas of track finding and pattern recognition. The most rudimentary version, called Templates-Algorithm, deals with the information of fired cells. This algorithm investigates the cell hit pattern of one event and outputs all paths of cells matching with templates, learned in an earlier stage. Tracks being found by this programm are the so called pointing tracks; i.e. tracks coming from the vertex region and exceeding some minimum momentum threshold. The accuracy of predictions of space points at this stage of pattern recognition will be of the order of the cell width. In the last chapter it is shown that the Templates-Algorithm may become the basis of the FTD second level trigger decision. (orig.).

13311 (BONN-IR–90-30) **Measurement and parametrization of the magnetic field in the solenoid magnet of the OPAL detector.** Grundmann, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1990. 58p. (In German). Order Number DE91756618. Source: OSTI; NTIS (US Sales Only); INIS.

The momentum measurement with the OPAL jet chamber requires the knowledge of the magnetic field inside the chamber volume. The three components of the field inside the solenoid were measured at 7920 regulary spaced positions by means of 132 Hall-probes. A careful data reduction yielded a map of the field inside the coil volume. The influence of systematic effects was investigated with special emphasis. Various parametrisations of the field were obtained using Legendre polynomial expansions. The field inside the jet chamber region can be described with 11 respective 21 parameters. For a description of the field inside the entire volume covered by the measurements 29 parameters are needed. An alternative parametrisation of the field distributions with 9 parameters by superposition of the fields of four current loops has been developed. (orig.).

13312 (BONN-IR–90-34) **Construction and test of a proton detector.** Kranefeld, G. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1990. 57p. (In German). Order Number DE91754953. Source: OSTI; NTIS (US Sales Only); INIS.

Nonmagnetic proton detectors will be used in future at the ELAN experiment. For this purpose a prototype of a proton telescope has being designed. The detector consists of three scintillation counters which are used as dE/dx counter, energy (stopping) counter and veto counter. This telescope was calibrated by using elastic electron proton scattering and tested with quasielastic electrodisintegration of the deuteron. These are no principal problems to identify the protons. In the electrodisintegration of the deuteron a missing mass resolution of $\pm$ 5.1 MeV was achieved. It has been shown, that such detectors are well suited for proton detection. (orig.).

13313 (BONN-IR–90-45) **Calibration of the ZEUS forward calorimeter.** Kraemer, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 85p. (In German). Order Number DE91756662. Source: OSTI; NTIS (US Sales Only); INIS.

The physics at the ep-collider HERA requires high resolution calorimetry calibrated with an accuracy of better than 2%. The ZEUS detector meets these conditions by means of a compensating uranium scintillator sandwich calorimeter with an energy resolution of $\sigma/E = 35\%/\sqrt{E} + \sigma_{cal}$, where σ_{cal} is the calibration error. One of the tools to minimize σ_{cal} is the calibration with the signals of the radioactivity of the Uranium plates (UNO). Taking UNO data every 8 hours keeps the calibration stable within $\simeq$ 1%. The muon calibration is done employing an algorithm, that determines the most probable energy loss with a precision of $\simeq$ 1%. The channel-to-channel fluctuations of the ratio μ/UNO for a forward calorimeter (FCAL) prototype show a spread of 5.2% for the electromagnetic calorimeter and $\simeq$ 2.5% for the hadronic sections. Improvements in the construction of the FCAL modules decreased these fluctuations to 2.0% and $\simeq$ 1.8% respectively. The influence of the cracks between the calorimeter modules amounts to $\simeq$ 1.7% on average for the ZEUS geometry, if a 2 mm thick Pb-sheet is introduced between the modules. We conclude that we are able to keep σ_{cal} below 2%. (orig.).

13314 (BONN-IR–90-46) **Study of the characteristic properties of the tagging system at the PHOENICS experiment.** Breuer, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 45p. (In German). Order Number DE91756659. Source: OSTI; NTIS (US Sales Only); INIS.

The tagging system of the PHOENICS-Experiment at ELSA is designed to cover a photon energy range of 200 MeV $< E_\gamma <$ 950 MeV for an initial electron energy E_0 = 1 GeV, giving a resolution 5 MeV $< \Delta E_\gamma <$ 10 MeV. The mean photon energies of the 128 energy defining scintillation counters in the tagging hodoscope have been determined experimentally using a total absorbing NaI(Tl) shower detector. The energy resolution of the tagging counters has been estimated from the experimental data. The results give good agreement with the design values. The signal/background ratio of the counting rates of the tagging system reaches values up to 500 using a radiator of 10^{-3} radiation lengths. The tagging efficiency for the uncollimated photon beam has been shown to be > 90% for most of the tagging counters. (orig.).

13315 (DESY–90-100) **Test of a prototype of the ZEUS backing calorimeter.** Kudla, I. (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej); Nowak, R.J.; Walczak, R.; Zarnecki, A.F.; Abramowicz, H. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Aug 1990. 36p. Order Number DE91754932. Source: OSTI; NTIS (US Sales Only); INIS.

We have studied the performance of a high resolution uranium-scintillator calorimeter by a much coarser backing calorimeter, made out of iron plates interleaved with planes of limited streamer tubes. The test results, obtained at the CERN-SPS hadron beam, show that the backing calorimeter can be used either to veto events with significant energy leakage from the uranium calorimeter or to correct for the energy. In both cases the energy resolution of the combined calorimeters improves significantly compared to the uranium calorimeter alone. (orig.).

13316 (DOE/ER/03069–1955) **Summary of drift velocity measurement on Ar-CH_4 mixtures.** Chang, Y.H.; Sarakinos, M.; Smith, B. Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Nuclear Science. 29 Jan 1991. 14p. Sponsored by USDOE,. DOE Contract AC02-76ER03069. Order Number DE91009049. Source: OSTI; NTIS; GPO Dep.

This experiment is set up to measure the drift velocities and magnetic deflection angle of various gas mixtures using a laser to simulate a particle path through a drift chamber. An Argon and Methane (90:10) mixture, which is also called P10, was used for the calibration of the apparatus because it has a very sensitive velocity peak at an electric field strength of approximately 150 volts/cm. The nature of these problems was discovered after a series of tests. First, the transducer which measures the partial pressure in the mixing procedure was incorrectly calibrated. Second, if CH_4 is filled after argon in the mixing procedure, CH_4 seems to stay in the upper part of the bottle. It takes much longer than an hour for the gases to fully mix. This problem does not exist if CH_4 is filled first. Third, measurements on deliberately contaminated P10 gas show the data taken before vacuuming the chamber overnight is likely to suffer from contamination, presumably G10 outgassing. Alignment does not seem to pose a problem because measurements taken before and after realignment of the chamber yield results within 0.5% of each other. This paper will elaborate these findings and present the measured results.

13317 (DOE/ER/40224–135) **[Theory of elementary particles studies in weak interaction and grand unification and studies in accelerator design]: Task C, Experimental high energy physics: Progress report.** Brau, J.E. Oregon Univ., Eugene,

OR (USA). Inst. of Theoretical Science. [1990]. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. Order Number DE91009587. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research being conducted at Mark 2, experiments dealing with SLD; the Tau-charm factory; empact; expression of interest; and silicon calorimetry subsystem R&B. (LSP)

13318 (DOE/ER/40224–177) **Neutron flux suppression with polyethylene moderators in the EMPACT silicon EM calorimeter.** Furuno, Koichiro; Brau, J.E.; Frey, R.E.; Hough, W.; Hwang, Hyun; Lefevre, H.; Park, Hwanbae. Oregon Univ., Eugene, OR (USA). Dept. of Physics. [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (CONF-9010212–40: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91009564. Source: OSTI; NTIS; INIS; GPO Dep.

While there are a number of advantages in using silicon detectors in calorimetry, the radiation hardness will be the main issue to be solved at the SSC. The most hostile radiation in the calorimeter comes from low energy (MeV) neutrons. We report on work based on the EMPACT option of the calorimeter. The Monte Carlo calculations show that the silicon EM calorimeter can be significantly hardened by adding thin polyethylene sheets in each of the sampling gaps and inserting a thicker shield between EM and HAD sections. We present a preliminary neutron flux measurement result employing an activation detector technique at the University of Oregon 5 MeV Van de Graaff accelerator. 11 refs., 5 figs., 2 tabs.

13319 (DOE/ER/40224–178) **Low cost, large area silicon detectors for calorimetry.** Korde, R. (International Radiation Detectors, Torrance, CA (USA)); Furuno, K.; Hwang, H.; Brau, J.E.; Bugg, W.M. Oregon Univ., Eugene, OR (USA). [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (CONF-9010212–39: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91009488. Source: OSTI; NTIS; INIS; GPO Dep.

Trapezoidal detectors with 28 cm^2 active area have been fabricated on >2500 Ωcm, 4 in. diameter n-type silicon wafers. Instead of the commonly used ion implantation method, low-cost, high volume solid state diffusion technology along with phosphosilicate-glass and TCA gettering was adopted for boron and phosphorus doping. Typically the diode dark current was 15 μA @ 100 volts. Efforts are being made to obtain a finished device yield of 80% to meet the $2/$cm^2$ price goal of SSC semiconductor detector group. 20 refs., 4 figs.

13320 (DOE/ER/40318–T2) **[High energy physics at the University of Iowa]: Progress report of research activities in the year 1990.** Mallik, U. Iowa Univ., Iowa City, IA (USA). Dept. of Physics and Astronomy. [1990]. 25p. Sponsored by USDOE,. DOE Contract AC02-87ER40318. Order Number DE91008003. Source: OSTI; NTIS; INIS; GPO Dep.

This past year, all professional activities have centered around ZEUS. At the International Calorimetry Conference in HEP (ICCHEP) at Fermilab at the end of October, I presented preliminary results of the FNAL testbeam effort on the calibration of the Barrel Calorimeter Modules on behalf of the US part of the collaboration, AMZEUS. I have also presented software status report on analyses results, at every collaboration meeting at DESY; on several occasions these presentations were in the plenary sessions. In the most recent meeting (September 1990), I chaired the concluding plenary sessions. I am also serving on the Executive Committees of both the ZEUS and the AMZEUS collaboration. For the Spring 1991 testbeam run at Fermilab, I will serve as the deputy spokesperson.

13321 (DOE/MC/25048–2962) **Collaborative research on fluidization employing computer-aided particle tracking: Quarterly report No. 6, July 1–September 30, 1990.** Chen, M.M. Illinois Univ., Urbana, IL (USA). Dept. of Mechanical and Industrial Engineering. [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC21-88MC25048. Order Number DE91008911. Source: OSTI; NTIS; GPO Dep.

In July, the complete TCAPTA instrument was shipped to METC. In early August, setup and preliminary test of the TCAPTA for the METC 1-foot fluidized bed unit was conducted by METC and UIUC personnel. Following the same procedure as described in the report for the period January 1–March 31, 1990, the detector was found to saturated when the tracer was located 90 mm away from the center of the crystal at 0.5 mCi source strength and 1300 V detector power supply. The detectors were then located 264 mm from the center line of the bed, which is equivalent to a clearance of 76 mm between the detector front surface and the outside surface of the bed. The discriminator threshold was set at 28.4 mV for an apparent detector signal height of 50 mV. Two calibrations were performed. Data were collected for a continuous four hour run with a sampling interval of 20 ms. The data were brought to UIUC for processing. In UIUC, the accuracy of the calibrations were analyzed first. It was found that the standard deviation for the empty bed calibration was about 20 mm, whereas the deviation was more than doubled for the second calibration, when the radiation was attenuated by both the wall and the particles. Using these calibration data, the calculated solids mean velocity and bulk density distributions had very low accuracy. It was then decided that a study of the nature of the gamma radiation attenuation through materials should be made in order to make corrections in processing the experimental data. Actual attenuation in experimental measurement depends not only on material property and geometry, but also on the discriminator setting which affects the contributions of the small angle scattered radiation. Critical experimental studies of the attenuation process is now planned in order to optimize the detection process and provide data for a corrosion scheme to be incorporated in the data processing software. 1 ref., 4 figs.

13322 (EPA–520/5-90-032) **NAREL [National Air and Standard Environmental Laboratory] standard operating procedures for radon-222 measurement using diffusion barrier charcoal canisters.** Gray, D.J.; Windham, S.T. National Air and Radiation Environmental Lab., Montgomery, AL (USA). Nov 1990. 33p. Sponsored by Env. Source: OSTI; US-EPA, Office of Radiation Programs, NAREL, 1504 Avenue A, Montgomery, AL 36115-2601.

Radon monitoring procedures for the National Air and Radiation Environment Laboratory (NAREL) are described. Radon is detected by sorption to activated charcoal, followed by detection of gamma ray emissions from the radon decay products lead-214 (295 KeV and 392 KeV) and bismuth-214 (609 KeV). The activated charcoal is held in an 8 ounce metal can, under a polyethylene diffusion barrier and a stainless steel screen, 30–50% open. The polyethylene barrier reduces water absorption by the charcoal, and improves integration over the exposure period. The proper use of the container is described, as is the counting system and calibration of the detecting system. Fabrication of reference standards and background canisters is described. Equations and sample calculations to determine radon concentrations are given. All terms in the equation are defined, and all calibration factors are calculated. The minimal detectable amounts of radon as a function of detector exposure time are calculated. 5 refs., 7 figs., 1 tab. (MHB)

13323 (Juel-Spez–548) **The SV4 program system. An operating program for efficient utilization of (triaxial) neutron spectrometers.** Monkenbusch, M. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Festkoerperforschung. Jan 1990. 130p. (In German). Order Number DE91756240. Source: OSTI; NTIS (US Sales Only); INIS.

The electronic control system of the SV4a triaxial neutron spectrometer in the DIDO reactor was completely revised. Within the framework of the backfitting work, a new concept was established for the control program of the reactor experimental computer. The PDP11 of the former configuration was replaced by an IBM AT03 computer, and the CAMAC bus system was replaced by the SMP bus system (Siemens). An independent, fixed-programmed control unit (S5, Siemens) actuates the motor driving units upon end switching and signalling contacts and thus protects the instrument from destruction by operating errors or computer malfunctions. Now controllable functions to be mentioned are: Sample temperatures, external field parameters represented by voltages, the two tilting angles at sample holder, and the beam limiting diaphragms ahead of and behind the sample. The diaphragms and crystal-tilting devices for adustment of the monochromator and the filters

at the monochromator exit likewise were made accessible by automatic, computer-controlled processes. (orig./DG).

13324 (KFK–4762) **Determining the lower limit of detection in contamination measurements with ratemeters.** Dilger, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Hauptabteilung Sicherheit. Oct 1990. 17p. (In German). Order Number DE91759265. Source: OSTI; NTIS (US Sales Only); INIS.

Formulas are derived for calculating the limits of detection and identification when the ratemeter is used to measure contaminations. A distinction is made between steady-state and dynamic measurements. It appears that with specified limits of surface activity, of background rate and of surface response value pairs can be found with minimum response and measurement times or response and scanning times. (orig.).

13325 (KFK–4784) **Gamma-spectroscopic measurements of the ^{235}U isotope abundance in a UF_6 sample (performed in the framework of the REIMEP-86 interlaboratory exercise).** Matussek, P. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernphysik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung. Oct 1990. 107p. (PWA–36/90). Order Number DE91759264. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the measurement of the U-235/U isotope abundance in a certified UF_6 sample by means of gamma spectrometry. The work was performed in the framework of the REIMEP-86 interlaboratory exercise. The U-235/U abundance value obtained from the measurements presented in this report was 3.5005 $\pm$ 0.0031% U-235/U which compares very well to the certified value of 3.5001 $\pm$ 0.0010% U-235/U. The report describes in detail the experimental set-up, the data evaluation and the error analysis. Some hints are given to improve the precision and to reduce the measurement time in future experiments of this type. (orig.).

13326 (LA–12029) **Superconducting Super Collider silicon tracking subsystem research and development.** Miller, W.O. (Los Alamos National Lab., NM (USA)); Thompson, T.C.; Ziock, H.J.; Gamble, M.T. Los Alamos National Lab., NM (USA). Dec 1990. 72p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91009227. Source: OSTI; NTIS; INIS; GPO Dep.

The Alamos National Laboratory Mechanical Engineering and Electronics Division has been investigating silicon-based elementary particle tracking device technology as part of the Superconducting Super Collider-sponsored silicon subsystem collaboration. Structural, materials, and thermal issues have been addressed. This paper explores detector structural integrity and stability, including detailed finite element models of the silicon wafer support and predictive methods used in designing with advanced composite materials. The current design comprises a magnesium metal matrix composite (MMC) truss space frame to provide a sparse support structure for the complex array of silicon detectors. This design satisfies the 25-μm structural stability requirement in a 10-Mrad radiation environment. This stability is achieved without exceeding the stringent particle interaction constraints set at 2.5% of a radiation length. Materials studies have considered thermal expansion, elastic modulus, resistance to radiation and chemicals, and manufacturability of numerous candidate materials. Based on optimization of these parameters, the MMC space frame will possess a coefficient of thermal expansion (CTE) near zero to avoid thermally induced distortions, whereas the cooling rings, which support the silicon detectors and heat pipe network, will probably be constructed of a graphite/epoxy composite whose CTE is engineered to match that of silicon. Results from radiation, chemical, and static loading tests are compared with analytical predictions and discussed. Electronic thermal loading and its efficient dissipation using heat pipe cooling technology are discussed. Calculations and preliminary designs for a sprayed-on graphite wick structure are presented. A hydrocarbon such as butane appears to be a superior choice of heat pipe working fluid based on cooling, handling, and safety criteria.

13327 (LA-UR–91-339) **Reproducible neutron emission measurements from Ti metal in pressurized D_2 gas.** Menlove, H.O. (Los Alamos National Lab., NM (USA)); Paciotti, M.A.; Claytor, T.N.; Maltrud, H.R.; Rivera, O.M.; Tuggle, D.G.; Jones, S.E. Los Alamos National Lab., NM (USA). [1990]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9010266–2: Conference on anomalous nuclear effects in deuterium/solid systems, Provo, UT (USA), 22-24 Oct 1990). Order Number DE91008578. Source: OSTI; NTIS; INIS; GPO Dep.

During the past year, we have measured neutron emission from samples of titanium (Ti) metal and sponge in pressurized D_2 gas. In January 1990, we improved our sample preparation procedure and our detector sensitivity level so that the neutron-emission measurements are now reproducible, but not yet predictable. We have measured excess neutron emission from the majority of our most recent samples using our high-sensitivity neutron detectors. The improved sensitivity in our new detector system was obtained by using low-radioactive-background stainless steel tubes, a small detector volume with high efficiency, and additional cosmic-ray shielding. Our most sensitive detector consists of two independent segments making up inner and outer rings of ^{3}He tubes. The combined total efficiency is 44%. In addition to inner and outer ring segments, we have three separate detector systems operating in parallel control experiments to monitor environmental change. We have measured neutron bursts from a variety of samples containing Ti metal and D_2 gas. The low-multiplicity bursts, emitting from 2 to 10 n, occur much more frequently than the higher multiplicity bursts. By measuring high-mass samples (300 g Ti) over several weeks, with many liquid nitrogen temperature cycles, we have detected neutron emission above the background from most of the samples with a significance level of 3 to 9 σ. 10 refs., 7 figs., 2 tabs.

13328 (LBL–29055) **Low power shaper amplifier for the EOS TPC detector.** Nakamura, M.; Landis, D.A.; Rai, G. Lawrence Berkeley Lab., CA (USA). Oct 1990. 7p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9010220–28: 1990 IEEE nuclear science symposium, Arlington, VA (USA), 23-27 Oct 1990). Order Number DE91009095. Source: OSTI; NTIS; GPO Dep.

A shaper amplifier is described that is designed for low power and small size which are important requisites for the Equation of State (EOS) time projection chamber (TPC) detector. The shaper amplifier produces a semi-Gaussian pulse with a peaking time of 210 ns. It dissipates less than 35 mW and has a gain of 4.5. A unique driver circuit capable of driving large capacitive loads and yet requiring low standby current is introduced. 2 refs., 6 figs.

13329 (LBL–29057) **Data links for the EOS TPC.** Bieser, F.; Jones, R.; McParland, C. Lawrence Berkeley Lab., CA (USA). Oct 1990. 5p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9010220–27: 1990 IEEE nuclear science symposium, Arlington, VA (USA), 23-27 Oct 1990). Order Number DE91009078. Source: OSTI; NTIS; INIS; GPO Dep.

We report on the design and performance of high speed data links and slower configuration control links used between the EOS TPC detector and the data processing electronics. Data rates of 5MBytes/s/link are maintained over 30m with optical isolation. Pedestal subtraction, hi* detection, and data reordering are performed online. 3 refs., 1 fig.

13330 (LBL–30222) **Test results of a 90 MHZ integrated circuit sixteen channel analog pipeline for SSC detector calorimetry.** Kleinfelder, S.A.; Levi, M.; Milgrome, O. Lawrence Berkeley Lab., CA (USA). Oct 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9010212–41: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91009773. Source: OSTI; NTIS; GPO Dep.

A sixteen channel analog transient recorder with 128 cells per channel has been fabricated as an integrated circuit and tested at speeds of up to 90 MHz. The circuit uses a switched capacitor array technology to achieve a simultaneous read and write capability and twelve bit dynamic range. The high performance of this part should satisfy the demanding electronics requirements of calorimeter detectors at the SSC. The circuit parameters and test results are presented. 2 refs., 3 figs., 1 tab.

13331 (LBL–30292) **Hydrogenated amorphous silicon radiation detectors: Material parameters, radiation hardness, charge collection.** Qureshi, S. Lawrence Berkeley Lab., CA (USA). Jan 1991. 138p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. Order Number DE91009082. Source: OSTI; NTIS; INIS; GPO Dep.

For nearly two decades now hydrogenated amorphous silicon has generated considerable interest for its potential use in various device applications namely, solar cells, electrolithography, large-area electronics etc. The development of efficient and economic solar cells has been on the forefront of this research. This interest in hydrogenated amorphous silicon has been motivated by the fact that amorphous silicon can be deposited over a large area at relatively low cost compared to crystalline silicon. Hydrogenated amorphous silicon, frequently abbreviated as a-Si:H, used in solar-cell applications is a micron or less thick. The basic device structure is a p-i-n diode where the i layer is the active layer for radiation to interact. This is so because intrinsic a-Si:H has superior electrical properties in comparison to doped a-Si:H which serves the purpose of forming a potential barrier on either end of the i layer. The research presented in this dissertation was undertaken to study the properties of a-Si:H for radiation detection applications in physics and medicine.

13332 (NIKHEF-H–90-13) **Operation of the microstrip gas detector.** Hartjes, F. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H); Hendriksen, B.; Schmitz, J.; Schuijlenburg, H.; Udo, F. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Sep 1990. 22p. (CONF-9009343–: 2. London conference on position-sensitive detectors, London (UK), 4-7 Sep 1990). Order Number DE91622816. Source: OSTI; NTIS (US Sales Only); INIS.

The article describes the operation of a detector of ionizing particles using metal strips deposited on an insulating substrate to collect and amplify the electrons liberated in the counter gas. It will be demonstrated, that minimum ionizing particles can be well detected with a good accuracy. A number for the stability of the gas gain will be deduced, the upper limit of the gain will be discussed. A circuit to avoid damage by micro-discharges will be presented. (author). 5 refs.; 11 figs.

13333 (ORNL/TM–11748) **Sensitivity comparison of intrinsic germanium detectors with various efficiencies.** Buker, L.M.L. Oak Ridge National Lab., TN (USA). Dec 1990. 93p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008113. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Univ. of Tennessee, Knoxville.

Scientists today are being asked to measure concentrations of radionuclides at increasingly lower levels. This creates a demand for better resolution detectors with larger efficiencies that can provide the necessary sensitivity to accurately determine low levels of radioactivity. This study has acquired a large volume of empirical data for a wide range of relative efficiency germanium detectors. The purpose was to determine the sensitivity of various efficiency high-purity (P-type) germanium detectors produced by a single manufacturer. Selecting efficiency as the only variable and essentially all other variables remaining constant narrowed the field of detectors to 30. This investigation compares the response for the lower limit of detection (LLD), figure-of-merit (FOM), and minimum detectable activity (MDA) versus efficiency. In addition to the efficiency, the resolution, background, peak-to-Compton (P/C), and crystal shape of a p-type detector are of particular importance when considering the parameters of a detectors performance. A concise summary of the results is that the detector of choice for low energy measurements would be a 25% detector with resolution better than 1.8 keV FWHM for the 1.332 keV energy of Co-60. The detector of choice for energy levels greater than 500 keV would be a high efficiency low background detector. If the entire energy range is of interest, then a 70% low background detector with a high P/C and a resolution better than 1.9 keV would yield the lowest MDA and assure the most efficient counting times. 9 refs., 25 figs., 6 tabs.

13334 (PCCF-T–9002) **Simulations of the zero degree detector response (part of the 4Π detector implanted at GSI-Darmstadt); study of Fai and Randrup model and contribution at the detector resolution.** Qassoud, D. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire; Clermont-Ferrand-1 Univ., 63 - Aubiere (France). Jun 1990. 158p. (In French). Order Number DE91757084. Source: OSTI; NTIS (US Sales Only).

The study developed in this thesis concerns simulations of the zero degree detector or inner wall which is a part of the 4Π detector implanted at G.S.I.-Darmstadt; On the other hand, we study the collective flow of nuclear matter in the reaction plane. These simulations are based on the statistical model of G. FAI and J. RANDRUP which is performed by the computer code FREESCO which generates the particles emitted from the collision. Some results extracted from this code show that the multiplicity of particles and fragments emitted from the Au + Au collision at 1 GeV/u is very high and that half of these particles and fragments are neutral ones. The simulation of the inner wall takes into account, for the particles and fragments emitted between 0 and 7.5 degrees, the calculation of the energy loss, the fluctuations of that energy loss and the Coulomb multiple scattering in the different materials between the target and the inner wall. The results of these simulations show the good identification of the different charges detected on the inner wall and exhibit the good efficiency of this detector. The resolution of the reaction plane reconstruction is in qualitative agreement with the experimental results of the plastic Ball but the calculations do not allow extracting a nuclear matter flow value from the only inner wall data. Nevertheless a value of this observable can be extracted quite well from the data of the 0^0-30^0 range, corresponding to the whole plastic wall of the 4Π detector at G.S.I.-Darmstadt.

13335 (SLAC-PUB–5365-Rev.) **Component and system tests of the SLD Cerenkov Ring Imaging Detector: Revision.** Antilogus, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); Aston, D.; Bienz, T.; Bird, F.; Dasu, S.; Dolinsky, S.; Dunwoodie, W.; Hallewell, G.; Kawahara, H.; Kwon, Y.; Leith, D.; Muller, D.; Nagamine, T.; Pavel, T.; Ratcliff, B.; Rensing, PStanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515 ;AT03-76ER70023. Grant PHY88-13669;Grant PHY88-13018. (CONF-9010220–13: 1990 IEEE nuclear science symposium, Arlington, VA (USA), 23-27 Oct 1990). Order Number DE91009365. Source: OSTI; NTIS; INIS; GPO Dep.

The components of the SLD barrel Cerenkov Ring Imaging Detector (CRID) are now built and are being installed. We report on tests of these, including tests of the fiber optic calibration system, detailed studies of electron drift paths on production drift boxes and detectors, tests of the dynamic gating system and its effect on drift path distortions due to space-charge, and a measurement of the electron lifetime in a production drift box. In addition, we report on the UV transmission of recirculated liquid C_6F_{14} and on the effects of CRID construction materials on electron lifetime. 9 refs., 11 figs.

13336 (SSCL-SR–1146) **Solenoidal Detector Collaboration resource requirements report.** Kadel, R.W. (ed.). Superconducting Super Collider Lab., Dallas, TX (USA). Dec 1990. 196p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. Order Number DE91009742. Source: OSTI; NTIS; INIS; GPO Dep.

This document contains design criteria and requirements for the Solenoid Detector Collaboration's (SDC) proposed detector for the Superconducting Super Collider. The proposed detector is optimized for high-p_t physics; it also has diverse capabilities that make it a premier exploratory tool for a broad range of physics topics. The intent is to construct a detector whose subsystems are fully functional at the design luminosity of $10^{33}cm^{-2}s^{-1}$, and which, with somewhat reduced functionality, can pursue the more specialized physics issues which require substantially higher luminosity. The document includes a description of the detector and its associated subsystems, experimental halls, surface facilities, assembly and construction, repair time estimates, operational requirements, safety considerations, test beam data, costs, schedules, alternative systems, and appropriate references. Figures and tables support the textual information.

13337 (UCRL–52000-90-11-12) **Energy & technology review, November–December 1990.** Johnson, K.C.; Martz, H.E.; de

Vore, L.; Gleason, K.; Sanford, N.M. (eds.). Lawrence Livermore National Lab., CA (USA). 1990. 56p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008244. Source: OSTI; NTIS; GPO Dep.

This report discusses progress in computerized tomography scanners; computerized tomography reconstruction technologies; and applications of computerized tomography.

13338 (UCRL-JC–104768) **Microwave measurements of the water content of bentonite.** Latorre, V.R.; Glenn, H.D. Lawrence Livermore National Lab., CA (USA). Jan 1991. 14p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910435–50: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91008085. Source: OSTI; NTIS; INIS; GPO Dep.

The theory of operation of microwave coaxial resonators is described. Sample preparation and the application of resonator techniques to the measurement of the permittivity (dielectric constant) of bentonite is discussed. The results indicate a fairly linear change in resonant frequency for saturation levels at 10, 30, 50, 70, and 90%. The results clearly demonstrate that this microwave technique is a viable method for measuring water content of soils. A discussion of additional applications of microwave methods for determining water content in materials is presented. 3 refs., 5 figs.

13339 (UCRL-JC–105237) **Industrial computerized tomography applications.** Martz, H.E.; Schneberk, D.J.; Azevedo, S.G. Lawrence Livermore National Lab., CA (USA). Feb 1991. 5p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910399–2: American Society for Nondestructive Testing spring conference, Oakland, CA (USA), 18-22 Mar 1991). Order Number DE91008454. Source: OSTI; NTIS; GPO Dep.

Over the past five years, we have performed research and developed many computerized tomography (CT) systems. Our CT R&D efforts have been concentrated in three main areas: scanners, software tools, and applications. The first two areas are discussed in the next section. The CT systems (scanners and software tools) have been used to nondestructively evaluate (NDE) many industrial objects as discussed in the Applications section. We end by summarizing the use of these systems in NDE applications. 8 refs.

13340 (UCRL-JC–105645) **An electro-optical imaging approach to the prompt signal processing problem of mega-channel SSC detector arrays.** Lowry, M.; Ables, E.; Bionta, R.; Haigh, R.; Hugenberg, K.; Kalibjian, R.; McConaghy, C.; Milton, D.; Rotter, M.; Schulte, H. Lawrence Livermore National Lab., CA (USA). Dec 1990. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9010212–36: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91008739. Source: OSTI; NTIS; INIS; GPO Dep.

The physics demands of high luminosity at the SSC and the sometimes subtle measurements required to elucidate new physics will undoubtedly tax existing instrumentation. As is the case with most experimental fields, new physics follows from better measurement concepts and technologies. We expect this to be the case with the SSC as well. In what follows, we offer a glimpse of what may be possible using some of the recent results from the emerging technologies in the field of electro-optics. 12 refs., 4 figs.

13341 (UCRL-JC–105646) **Electro-optic transient imaging instrumentation development at Lawrence Livermore National Laboratory: Implications for SSC instrumentation development.** Lowry, M.; Jacoby, B.; Schulte, H. Lawrence Livermore National Lab., CA (USA). Dec 1990. 5p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9010212–37: Symposium on detector research and development for the Superconducting Super Collider, Fort Worth, TX (USA), 15-18 Oct 1990). Order Number DE91008738. Source: OSTI; NTIS; INIS; GPO Dep.

Over the last decade, the underground weapons physics laboratories fielded by LLNL's Nuclear Test and Experimental Sciences (NTES) program have experienced marked change. This change is characterized by a phenomenal growth in the amount of data returned per event. These techniques have been developed as a result of the severe demands placed upon transient instrumentation by the physics requirements of our underground nuclear laboratories. The detector front-ends must quickly detect, process and transmit a large volume of data to recording stations located approximately 1 km from the event. In a recent event, the detector front-ends successfully handled data at a prompt rate of approximately 13 Terabits/sec. Largely, this advance can be attributed directly to the increased use of electro-optic techniques. These highly-parallel high-bandwidth imaging instrumentation systems developed for the test program may have a lot to offer the high-energy physics community tackling the challenge of the unprecedented luminosity and fidelity demands at the SSC. In what follows, we discuss details of a few of our prompt instrumentation techniques and compare these capabilities to the detector requirements for the challenging physics at the SSC. 5 refs., 3 figs.

4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to citation(s) 12565, 12663, 13318, 13331

13342 (DESY–90-109) **Silicon detectors for calorimetry. Developments for H1 at HERA.** Lindstroem, G. (Hamburg Univ. (Germany, F.R.). 1. Inst. fuer Experimentalphysik); Eberle, M.; Fedder, I.; Fretwurst, E.; Pein, U.; Riech, V.; Schatz, H.; Seidel, M.; Wunstorf, R.; Zeitnitz, C.; Croitoru, N.; Darvas, R.; Seidman, A.; Boettger, R.; SchoelermDeutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 17p. Contract BMFT 055HH19I. (CONF-9003150–: 5. international conference on instrumentation for colliding beam physics, Novosibirsk (USSR), 15-21 Mar 1990). Order Number DE91756512. Source: OSTI; NTIS (US Sales Only); INIS.

Our group is responsible for the PLUG-calorimeter in the H1 experiment at HERA, which will fill the gap between the LAr forward calorimeter and the beam pipe. This angular range is extremely important since at HERA 800 GeV protons collide with 30 GeV electrons and thus an appreciable amount of transverse momentum and energy would otherwise be lost. Here we concentrate on problems connected with detector technology and performance, radiation damage and MC-simulations. (orig./HSI).

4404 Well Logging Instrumentation

13343 (UCRL-CR–106131) **Analysis of field placement data for hydrogen content test unit.** Walker, J.N. (Holmes and Narver, Inc., Orange, CA (USA)); O'Laughlin, C.L.; Barber, J.W. Lawrence Livermore National Lab., CA (USA); Holmes and Narver, Inc., Orange, CA (USA). [1991]. 221p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91008601. Source: OSTI; NTIS; GPO Dep.

As requested by Grant Bruesch of Fenix & Scisson of Nevada (FSN), the Special Projects Section (SP) of the Holmes & Narver (H&N) Materials Testing Laboratory has provided support during the fabrication of logging calibration chambers at the Hydrogen Content Test Unit Facility (HCTU). The chambers consisted of two large cylinders, each with a hollow interior and an outer ring divided into 6 cells. The project undertaken was to fill each cylinder with known amounts of granular material and water. By varying the mix parameters between the cylinders a range of known values are now available for use in calibrating downhole logging tools. This report will discuss the cells on a chapter basis, with each chapter similar in format. Each cell will be individually described in a chapter, and the chapter number will correlate with the cell number (e.g., Cell #1 is discussed in Chapter 1). In addition, all data for a cell will also be present in that chapter, (placement density data, water content test results, and calculated porosities and water saturations). The report was constructed in this manner so that there would be an easily indentifiable stand-alone section for each cell, thereby making it easier for future users to quickly locate the data desired. Cell #12 will not be discussed in this report since it consists solely of water. Instead Chapter 12 will present a brief summary of the project. 35 figs., 34 tabs.

4405 Thermal Instrumentation

Refer also to citation(s) 12429, 13865

13344 (DOE/ER/14125–1) **Photochemistry and charge transfer chemistry of the platinum group elements: Progress report, May 1, 1990–April 30, 1991.** Eisenberg, R. Rochester Univ., NY (USA). Dec 1990. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-90ER14125. Order Number DE91009153. Source: OSTI; NTIS; GPO Dep.

The research program focuses on the photochemistry and photophysics of dithiolate complexes of the platinum group elements. The specific systems under investigation are square planar complexes of Pt(2) containing one dithiolate chelate and two other ligands to complete the coordination sphere. Several members of the target series of compounds have been synthesized and found to exhibit luminescence in fluid solution. These initial complexes, shown as 1 and 2, possessed a diimine ligand such as bipyridine (bpy), o-phenanthroline (phen) or an alkyl substituted derivative in addition to the dithiolate chelate. For 1 the dithiolate was maleonitriledi-thiolate (mnt) and for 2 it was ethyl-2-cyano-3, 3-dithiolatoacrylate (ecda). Complexes 1 and 2 were observed to be highly solvatochromic, and the emission spectra of selected members gave evidence of multiple emitting states.

4406 Optical Instrumentation

Refer also to citation(s) 13519, 13529, 13591

13345 (DOE/ER/13708–T2) **Statistical fluctuations in lasers: Report of technical progress, June–December 1990.** Roy, R. Georgia Inst. of Tech., Atlanta, GA (USA). School of Physics. [1990]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-87ER13708. Order Number DE91009540. Source: OSTI; NTIS; GPO Dep.

This report discusses the detection of weak optical signals by super-regenerative laser receivers; studies of interaction of fluctuating fields with atoms; and investigation of four-wave mixing in optical fibers. (LSP)

13346 (UCRL-ID–104094) **Laser test for spindle parallelism.** Thompson, S.L.; Chung, Carl A. Lawrence Livermore National Lab., CA (USA). 15 May 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009716. Source: OSTI; NTIS; GPO Dep.

The purpose of this test was to check the sign convention of the straightness interferometer, when it was being used to assess a spindle for parallelism to a linear axis. The sign becomes all important when removing the alignment error of the straightness reflector, from the machine error. The following diagram illustrates what happens with a conventional straightedge, and indicator, assuming a perfect axis alignment (except for a bump near the headstock), and a deliberately misaligned straight edge.

13347 (UCRL-JC–105984) **The single antenna interferometer.** Fitch, J.P. Lawrence Livermore National Lab., CA (USA). 15 Jan 1990. 6p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9105122–1: 1991 Institute of Electrical and Electronics Engineers (IEEE) international conference on acoustics, speech and signal processing, Toronto (Canada), 14-17 May 1991). Order Number DE91007128. Source: OSTI; NTIS; GPO Dep.

Air and space borne platforms using synthetic aperture radars (SAR) have made interferometric measurements by using either two physical antennas mounted on one air-frame or two passes of one antenna over a scene. In this paper, a new interferometric technique using one pass of a single-antenna SAR system is proposed and demonstrated on data collected by the NASA-JPL AirSAR. Remotely sensed L-band microwave data are used to show the sensitivity of this technique to ocean surface features as well as a baseline for comparison with work by others using two-antenna systems. 7 refs., 3 figs.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 13865

13348 (GKSS–90/E/37) **A measurement system for turbulent fluxes in the surface layer.** Lohse, H. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik); Claussen, M.; Mueller, A.; Siewers, H.; Apel, U. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). 1990. 89p. (In German). Order Number DE91759521. Source: OSTI; NTIS (US Sales Only).

A system for direct measurements of turbulent fluxes of energy and momentum in the surface-layer is presented. This system consists of a SONIC-anemometer-thermometer (wind vector and temperature are recorded at approximately 20 Hz) and a Lyman-Alpha-Hygrometer (humidity is recorded at a frequency >20 Hz) together with absolute measurements of temperature and humidity (via recording of dry- and wet-bulb temperature as well as pressure) for a calibration of the fast sensors every half a minute. With special interfaces and software developed at GKSS recorded data are transfered to a computer which calculates absolute values of wind vector, temperature, and humidity as well as their auto and cross correlations. From these data fluxes of momentum, sensible and latent heat are deduced for a given time scale of integration. The acquisition of turbulence spectra and computation of higher statistical moments is possible. First successful measurements by use of this system were carried out during the field experiment 'ARKTIS 88'. (orig.) With 58 figs.

13349 (LBL–30081) **Imaging of conductivity distributions using audio-frequency electromagnetic data.** Lee, Ki Ha (Lawrence Berkeley Lab., CA (USA)); Morrison, H.F. Lawrence Berkeley Lab., CA (USA). Oct 1990. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-901281–1: International symposium on geotomography, Tokyo (Japan), 10-11 Dec 1990). Order Number DE91009331. Source: OSTI; NTIS; GPO Dep.

The objective of this study has been to develop mathematical methods for mapping conductivity distributions between boreholes using low frequency electromagnetic (em) data. In relation to this objective this paper presents two recent developments in high-resolution crosshole em imaging techniques. These are (1) audio-frequency diffusion tomography, and (2) a transform method in which low frequency data is first transformed into a wave-like field. The idea in the second approach is that we can then treat the transformed field using conventional techniques designed for wave field analysis.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 12455, 13203, 13422, 13518, 13865

13350 (AEA-TRS–5001) **The calibration of Andersen Mark-II and California measurements PC-2 QCM cascade impactors.** Horton, K.D.; Mitchell, J.P. AEA Thermal Reactor Services, Winfrith (UK). May 1990. 63p. (AEEW-TRS–5001.). Order Number DE91622827. Source: OSTI; NTIS (US Sales Only); INIS.

Andersen Mark-II and California Measurements PC-2 quartz-crystal (QCM) cascade impactors have been calibrated with monodisperse aerosol particles. Both the Andersen and QCM impactors were determined to be reliable instruments: the advantage of the QCM impactor is that real-time monitoring of aerosol behaviour is possible, using short measurement times. However, care is needed to interpret the QCM data if this instrument is used to sample aerosols that carry an unknown or significant electrostatic charge. (author).

13351 (AEEW-R–2617) **Polytec optical aerosol analysers: laboratory intercomparison.** Mitchell, J.P.; Lloyd, G.P.M.; Marshall, I.A. UKAEA Atomic Energy Establishment, Winfrith (UK). Chemistry Div. Mar 1990. 126p. Order Number DE91622828. Source: OSTI; NTIS (US Sales Only); INIS.

Polytec aerosol analysers size individual particles within the overall range from 0.3 to 100 μm diameter on the basis of right-angle scattering of white light as they enter a cube-shaped optically defined measurement volume. An experimental intercomparison of 10 Polytec instruments, representing all sizes of measurement volume, was carried out during the period November 1987 to January 1988. (author).

13352 (SAND–90-2519) **A self-cohering technique for linear arrays using the Phase Gradient Autofocus Algorithm.** Wahl, D.E. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009099. Source: OSTI; NTIS; GPO Dep.

A towed linear hydrophone array is subject to snakelike bending. If the array were processed as if it were truly linear, poor array gain coupled with a degraded source bearing estimate would result. The signal phase errors produced by sensor position uncertainty in passive sonar arrays are similar to those observed in Synthetic Aperture Radar (SAR) imagery. The Phase Gradient Autofocus (PGA) Algorithm has been shown to be a robust and effective method used to extract degrading phase errors prevalent in SAR imagery. This report shows that with slight modifications, the PGA algorithm can be applied to correct phase errors resulting from sensor position uncertainty introduced into linear-passive arrays. The results of the technique applied to simulated linear array data is also presented. 9 refs., 8 figs.

13353 (SAND–91-0327C) **Micromachined sensors and actuators.** Smith, B.K. Sandia National Labs., Albuquerque, NM (USA). [1991]. 7p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910279–9: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20 Feb 1991). Order Number DE91008257. Source: OSTI; NTIS; GPO Dep.

Micromachining is a rapidly growing field which allows for the fabrication of extremely small sensors and actuators using many of the techniques common to microelectronics. Two methods are commonly used: bulk micromachining, which involves the sculpting of single crystal silicon, and surface micromachining, which uses etched thin films that have been deposited on the substrate. Sensors are the primary commercial application, but microactuators are being actively researched at several laboratories and universities. Sandia National Laboratories is pursuing applications of both bulk and surface micromachining for silicon microsensors, microactuators, and high-performance, silicon packages for microelectronics. 3 figs.

13354 (UCRL-JC–105356) **Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages.** Kansa, E.J.; Stout, R.B. Lawrence Livermore National Lab., CA (USA). 30 Nov 1990. 32p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910598–1: 37. Instrument Society of America international instrumentation symposium, San Diego, CA (USA), 5-9 May 1991). Order Number DE91005061. Source: OSTI; NTIS; GPO Dep.

A triple-material stress-strain gage containing foils of ytterbium, manganin, and constantan was tested at LLNL. This gage yields three independent piezoresistance measurements from which an independent set of principal strains and principal stresses can be inferred. We have analyzed the signals from a gage at a specific location buried at a distance from the center of energy of an event at NTS. We inverted the resistivity signals to calculate the stress and strain histories as sensed by the foils. Using the elastic material properties and the traction and displacement conditions at the various material interfaces from the foils to the host geological medium, we calculated the stress and strain histories in the host geological medium. However, because of uncertainties in the elastic properties of the layers of surrounding materials, we calculated significant variations in both the peaks and signatures of the stress and strain histories that could produce the foil stress and strain histories. We conclude that, because of the inclusion problem, accurate measurements of the stress-strain histories in the host geological medium can be adequately addressed only by minimizing, as much as possible, such uncertainties.

13355 (WINCO–1082) **Axial, teflon-insulated, liquid-height capacitance probe and the effects of liquid-conductance.** Piper, T.C. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Jan 1991. 67p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-84ID12435. Order Number DE91007909. Source: OSTI; NTIS; INIS; GPO Dep.

The phase behavior of an insulated capacitance liquid height sensor is investigated in the region of $\epsilon\omega/\sigma$ near unity. The sensor drive current is found to deviate from 90 (from the drive voltage) by as much as 45 degrees at $\epsilon\omega/\sigma = 1$. Sensor $Y_{tot-imag}$ indicated liquid height errors of 10 centimeters for 100 centimeters liquid height are found easily possible if the liquid conductivity is not accurate known. A manner of iterating to the correct answer and simultaneously determining the liquid conductivity is given using special sensor electronics that utilize two phase referenced signal demodulator and a single board computer programmed with system admittance equations. 6 figs., 2 tabs.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 13223, 13420

13356 (FASAC-TAR–91008348) **Soviet atmospheric acoustics research.** McKenney, B.L.; McGrain, M. (eds.); Bass, H.E.; Lacoss, R.T.; Landers, T.E.; Powell, A.; Raspet, R.; Revell, J.D. Science Applications International Corp., McLean, VA (USA). Foreign Applied Sciences Assessment Center. Aug 1990. 227p. Source: OSTI; Science Applications International Corporation, 1710 Goodridge Dr., P.O. Box 1303, McLean, VA 22102.

The development of low observable air vehicles by the United States coupled with the historic propensity of the Soviet Union toward the defense of its borders raises the possibility of Soviet development of acoustic systems for detection and tracking of air vehicles as part of such defense. This report reviews and assesses Soviet research in atmospheric acoustics. Topics considered relevant were aircraft noise, background acoustic noise, propagation, meteorological remote sensing, microphone technology, processing of acoustic signals, and acoustic-gravity waves and ionospheric detection. This study should provide an indication of the maturity of the Soviet technology base required for the development of potential acoustic detection and tracking systems. Overall, the Soviet technology base in areas required for acoustic aircraft detection and tracking is at least comparable to that in the United States, and, in some areas, more advanced.

13357 (LA–11870-MS) **Interaction of strategic defenses with crisis stability: Part 1, Framework and analysis.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 58p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91009004. Source: OSTI; NTIS; GPO Dep.

Crisis stability indices calculated for two-sided strategic interactions are used to discuss the impact of boost and midcourse defenses. They largely suppress missiles, leaving bombers and cruise missiles to deliver the bulk of restrikes. Boost-phase defenses are able to attrit missile attacks, but lack the preferentiality needed to defend specific targets. Midcourse layers could protect a significant fraction of forces; combined defenses could defend more. Results are sensitive to decoys and target sets. 29 refs., 26 figs.

13358 (LA–11919-MS) **Interaction of strategic defenses with crisis stability: Part 2, Applications.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 57p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91009002. Source: OSTI; NTIS; GPO Dep.

Stability indices produce a picture of the transition from offensive to defensive deterrence. Now, fixed intercontinental ballistic missiles (ICBMs) act as a sink; submarine launched ballistic missiles (SLBMs) carry the brunt of retaliation; and aircraft add little. START would shift toward aircraft. Moderate defenses could suppress SLBMs, but would not protect a significant number of ICBMs. Retaliation would shift to aircraft, if protected and penetrating.

Combined boost- and midcourse defenses increase stability. Reductions of heavy ICBMs or launch on warning would have little impact. Unilateral defenses change crisis indices little, but reduce delivery. 19 refs., 36 figs.

13359 (LA–12058-MS) **Stability indices for limited strikes.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 25p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91009005. Source: OSTI; NTIS; GPO Dep.

This note uses the formalism derived earlier to discuss the stability indices for limited strikes of varying magnitudes. They exhibit monotonically increasing stability indices, which increase much faster than those for large strikes. When the restrike uses the same number of missiles and aircraft as the first strike, the resulting stability indices remain unity to within small model-dependent factors. 5 refs., 27 figs.

13360 (SAND–90-0610) **A comparison of calculational results with experimental data for long rod projectiles.** Hertel, E.S. Jr. Sandia National Labs., Albuquerque, NM (USA). Dec 1990. 35p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009006. Source: OSTI; NTIS; GPO Dep.

Calculations were performed with CTH (a finite difference hydrodynamics code) to evaluate computational capabilities for predicting residual projectile length and position in high velocity penetration events. The calculations simulated selected tests in a set of armor penetration experiments conducted and reported by Los Alamos National Laboratory. The tests and simulations involved penetration of armor ranging from 6.4 to 50.8 mm in thickness by long rod projectiles over a range of velocities from 1.0 to 1.29 km/sec. Comparisons are made between the calculated and measured final projectile lengths and positions, and the sensitivity of the predicted results to target and projectile property variations is investigated. 8 refs., 11 figs., 8 tabs.

13361 (UCRL-ID–105300) **Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s.** Abey, A.E.; Erickson, S.A.; Norquist, P.D. Lawrence Livermore National Lab., CA (USA). 1 Aug 1990. 27p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91009008. Source: OSTI; NTIS; GPO Dep.

Computer simulation predictions of the effectiveness of autonomous airborne vehicles in finding rail mobile SS-24s are presented. Effectiveness is discussed for several autonomous airborne vehicle endurances and survivabilities for the search area southwest of Moscow. The effect of where the Soviets place the SS-24s on the rail network was also investigated. The simulation predicts significant variations in the ability of a multi-autonomous airborne vehicle system to find SS-24s with these parameters. 12 figs., 1 tab.

13362 (UCRL-ID–105489) **Preliminary design of Viking Armored Gun System.** Gogolewski, R.P.; Cunningham, B.J. Lawrence Livermore National Lab., CA (USA). 24 Oct 1990. 15p. Sponsored by U.S. DOE Contract W-7405-ENG-48. Order Number DE91008073. Source: OSTI; NTIS; GPO Dep.

We have completed the preliminary design of our third lightweight armored fighting vehicle – the Viking Armored Gun System (AGS). The AGS vehicle features a two-man crew, the Ares 75mm Universal Turret System, and the John Deere 4026R Rotary Engine. In the spirit of our earlier AFV designs, our primary concern is to provide the AGS with sufficient firepower and survivability while utilizing "off-the-shelf" sub-systems and components in order to reduce developmental time and acquisition cost. We still envision that prototypic vehicles could be built within a thirty (30) month developmental/demonstration program. We still believe that vehicles of this class should be built and tested soon to assess their full tactical, operational, and strategic utilities.

13363 (UCRL-ID–105975) **Technique for evaluating attacker combat potential subsequent to a deep attack.** Olness, D.U.; Warshawsky, A.S. Lawrence Livermore National Lab., CA (USA). 21 Feb 1991. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91009007. Source: OSTI; NTIS; GPO Dep.

Several weapon systems are being developed for attacking enemy forces up to 25 or 30 km behind the forward line of own troops (FLOT). Candidates such as the terminal guidance warhead (TGW) and sense and destroy armor (SADARM) warhead are being considered for delivery by the multiple launch rocket system (MLRS) to provide the capability to attack armor and artillery forces over long distances. Such weapon systems can, for example, attack battalion-sized arrays of land-mobile targets while the targets are in tactical road marches to the forward lines. With these deep attacks, segments of the enemy forces can be countered before they can engage friendly forces. We are conducting an ongoing, comprehensive study of these advanced conventional munitions (ACM). The present force-on-force study represents an adjunct to the ACM study. The purpose of the present study is to estimate the effect that attacking a unit deep would have on that unit's subsequent combat effectiveness once committed to battle. To do this with a full scale combat simulation would be time consuming because one would have to model the deep attack, the subsequent movement to battle, and the eventual close battle. We developed a simple technique designed to provide such an estimate. The procedure is to model a typical attack against a prepared defense and record the results. The attacker force is then decremented to simulate losses due to prior deep attack and the close battle replayed. In this paper we describe the scenarios we used to obtain combat effectiveness estimates. In the third section of the document, we discuss the results of our simulations and quantify front-line force effectiveness as a function of the number of kills resulting from a postulated deep attack, assuming no replacements. 6 refs., 5 figs.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 13200

13364 (SAND–90-1691) **The MC3990A Detonator development program.** Tarbell, W.W. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 52p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009100. Source: OSTI; NTIS; GPO Dep.

The MC3990A Detonator is a hot-wire activated device developed to initiate the MC4030 Driver on the B61 and B90 weapon systems. The detonator design is significantly smaller than previous units of this type and uses a glass-ceramic substrate to seal the header. The glass ceramic necessitates the development of a new set of materials using Hastelloy-B for the connector and barrel and Inconel-718 for the header shell. The explosive CP is used in the ignition cavity and DDT (deflagration-to-detonation transition) column, with the output pellet made of HMX powder. Computer code analyses and test results are given to show that this component meets all system requirements. Reliability and performance margin calculations are also presented. 11 refs., 18 figs., 8 tabs.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 13111, 13354, 13583, 13584, 13585, 13586, 13743, 13921

13365 (CONF-8909163–Vol.1, pp. 3-39) **In-situ stress measurements made in conjunction with the Mighty Oak and Mission Ghost nuclear events.** Baldwin, M.J. (Fenix & Scisson of Nevada, Mercury (USA)); Townsend, D.R.; Hopkins, S.P.; Coffey, T.J.; LaComb, J.W. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

It has been postulated that a tamped explosion produces changes in the local in situ stress distribution, creating a residual stress field which may be important to the containment of the explosion products. The technique of inducing hydrofractures in bore holes, has been successfully used to detect changes in local stress orientations that are believed to indicate a remnant of the residual stress field. In an effort to detect and measure changes in in-situ stress directions produced by a nuclear explosion, the DNA conducted a series of hydrofracture tests after the MIGHTY OAK

event, and both before and after the MISSION GHOST event. Approximately six months after the U12t.08 MIGHTY OAK event, hydrofractures were produced at thirteen locations between 107 and 52 m from the WP, in a bore hole drilled radially toward the WP (Working Point). Subsequent mining along the hole revealed the dyed hydrofractures and permitted mapping of their orientations. A change in average hydrofracture orientation was observed as mining progressed toward the WP. Hydrofractures produced closer to the WP that in 75 m had a 40-degree deviation from that of the more distant hydrofracture group and roughly tangential to the MIGHTY OAK cavity. Prior to MISSION GHOST, local stresses were measured at locations 0 to 110 m from the proposed WP. Approximately seven months after the MISSION GHOST event, the DNA conducted a borehole-hydrofracture program similar to that carried out after MIGHTY OAK. Hydrofractures produced between 55 and 37 m from the WP averaged roughly due north in strike, very similar to the strikes of pre-event hydrofractures. The strikes of the post-event hydrofractures became progressively more easterly between approximately 31 and 24 m from the WP, at which point they were approximately tangential to the MISSION GHOST cavity.

13366 (CONF-8909163–Vol.1, pp. 40) **In situ stress relief measurements and initial analysis from a mine-by in U12P-tunnel.** Harris-West, B.L. (Defense Nuclear Agency, Mercury, NV (USA)); Fogel, M.B. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Quantifying the tunnel convergence phenomena has important implications in understanding the in situ medium character and stress field, both of which are used to model containment and structure response and to provide construction support. A new technique was used in the U12p.03 drifts to actively measure and record when and where tunnel convergence occurred in relation to the mined face. Six electromechanical gauges were installed in a series of holes perpendicular to and at ranges of 16.2 to 20.4 m from the Bypass drift to measure displacement as mining proceeded by in the parallel Main drift. The Main drift was mined over a 33.2-m section of tunnel from 7.6 m on the portal side of the first gauge anchor to more than 7.6 m on the working-point side of the last gauge anchor. Plots of these data indicated that displacement began well before the face was opposite the measurement station. The gauge farthest from the Main rib measured about half the displacement of the closer stations. Subsequently, the experiment was simulated using a two-dimensional, quasi-static finite element code. It was assumed that the rate of excavation allowed for the maintenance of static equilibrium. The excavation process can, therefore, be represented in a single calculation by a partially mined tunnel. Included are comparisons of the measured and computed displacements at different sand-offs from the mining interface and at different wall depths, as well as the shear modulus deduced from these data and that measured by Terra Tek for tuff at this site. The calculational analysis showed the experiment may provide a sensitive measurement of the in situ shear modulus for the tuff in the vicinity of the tunnel.

13367 (CONF-8909163–Vol.1, pp. 41-58) **Gage inclusion experiments.** Smith, C.W. (Sandia National Labs., Albuquerque, NM (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

To make field measurements of the free-field radial stress, one typically drill holes in the host rock and couple the gages to the rock with a grout material. Usually there is a mismatch of the mechanical properties of gage, installation grout, and host rock. The mismatch may produce peak values that are different from the free-field values and distort the waveshapes. This is the gage inclusion problem. To investigate this effect and provide data for comparison with modeling calculations, the author has fielded pairs of gages in which the gage package or the installation technique differed between the pairs. Experiments were conducted in four environments: wet tunnel bed tuff, a block of DSRM2 grout, Yuma soil, and partially saturated tuff. Data suggest that: (1) at stresses below one kilobar in wet tuff, specific gage types will show peak amplitudes of 65 to 70% of the peaks, and reduced impulses, shown by other gage types, (2) there are negligible inclusion effects at the two kilobar level in DSRM2 grout, (3) a gage package with a wave transit time longer than the risetime of the incident stress wave may overregister and distort the waveshape, and (4) geometry effects–a hole versus a slot–can generate different peak values.

13368 (CONF-8909163–Vol.1, pp. 61-71) **Development of the steel/aluminum composite gate for the modified auxiliary closure.** Chiu, R.Y. (Sandia National Labs., Albuquerque, NM (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The propulsion working fluid for the containment closure used at the Nevada Test Site consists of a mixture of a driver gas and the hot detonation products from the shaped charge that cuts the wall of the storage vessel. Nitrogen has always been used as the driver gas. However, helium gas, because of its superior propulsion characteristics, has enabled us to design considerably heavier and stronger gates. Operational times can be equal to or less than operational times when nitrogen gas was used. Assume, maintaining the same functional time, that an appreciably stronger steel/aluminum composite gate is designed and developed. The gate consists of two 314-in.-thick, high-strength 4340 circular steel plates imbedded in the two sides of the 7075-T73 aluminum forging. Mechanical circular keys are used to ensure the effective transfer of horizontal shear loads from aluminum to steel. Three point bending experiments on small composite beams were conducted to determine the effectiveness of the mechanical keying system. Also explored was structural adhesive used as a bonding and shear transfer mechanism.

13369 (CONF-8909163–Vol.1, pp. 72-104) **Plasma flow in PINEX diagnostic LOA [line-of-sight] pipes and a novel flow reduction scheme.** Reed, L.L. (S-CUBED, LaJolla, CA (USA)); Hollis, D.J. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

A common diagnostic used to obtain data from a PINEX line-of-sight (LOS) test is the PINEX camera. Other features of the PINEX pipestring are a series of beam collimators, pinhole collimators, and filters. Around the pipe are various shielding and stemming materials. All of these features of the pipestring influrnce the generation and flow of plasma in the pipe and processes associated with it. Occasionally, pipe flow has interfered with successful PINEX operation. Elucidating the pipe flow process by computer simulations is therefore desirable. A future LLNL event includes three PINEX diagnostic line-of-sight pipes. S-CUBED was asked to characterize plasma flow in two of the LOS pipes. Initial baseline calculations indicated that the pressure and velocity of the flow in the nominal pipes could be high enough to destroy the PINEX cameras before data could be recovered. Subsequent calculations suggested that these flow parameters, and their associated threat, can be significantly reduced by the inclusion of pressure activated closure systems (PACS) along the pipes. This paper describes calculations of several LLNL PINEX pipe flows both with and without PACS. Also discussed is a calculation of an executed LANL PINEX event. The CORRTEX data from this test provides a means of calibrating the calculations.

13370 (CONF-8909163–Vol.1, pp. 107-118) **Mighty Oak containment review.** Brownlee, R.R. (Los Alamos National Lab., NM (USA)); Chabai, A.J.; Hudson, B.C.; LaComb, J.W.; Peterson, E.W.; Higgins, G.H. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Containment of MIGHTY OAK was satisfactory in that there was no accidental release of radioactivity to the atmosphere whatsoever. However, the tunnel grout in the near-cavity region was not sufficiently constrained. Failure of this plug led to the subsequent failure of the mechanical closure systems and to the eventual flow of cavity gas, plug material, and other debris down the line-of-sight (LOS) pipe to the experiment chamber and the tunnel complex beyond. Consequently, little direct information in available concerning why the ground-motion/LOS pipe closure process failed to form an adequate plug. However, the authors have made an extensive review of relevant information available, including the containment system design, site geologic structure and materials property data, as-built installations, and previous experience. As a result, the authors have identified three design modifications that together they feel would have prevented the observed failure. These include: (1) using a mechanical LOS closure and abutment that has been strengthened to provide better confinement of the grout plug; (2) using alternating lengths of strong and weak grout to fill the LOS drift between the cavity and the MAC to avoid excessive motion (and loss) of the weak grout; and (3) using grout materials whose composition is such that their behavior will be reliable and reproducible. Additionally, the authors recommend improving the capabilities of the mechanical LOS closures so they better complement the ground-motion-induced closure. Other, more general recommendations are included in the following report.

13371 (CONF-8909163–Vol.1, pp. 119-137) **Containment design review for standard yield line-of-sight tests.** Peterson, E.W. (S-CUBED, La Jolla, CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The design and containment performance of the main line-of-sight drift containment system has been reviewed for MIGHTY OAK and the preceding seven standard yield events. These events, and the six other events that had comparable designs, all contained satisfactorily with no uncontrolled release of radioactivity to the atmosphere. However, during the last five events there was measurable leakage to the tunnel complex with that amount occurring on MIGHTY OAK and MISTY RAIN being operationally significant. This review compares nineteen features of the containment system designs for the selected eight events in an attempt to identify those parameters responsible for the observed variation in performance. The results suggest some possible correlations between specific design changes and containment performance. However, they also suggest that no single identified parameter change was responsible for the MIGHTY OAK and MISTY RAIN results.

13372 (CONF-8909163–Vol.1, pp. 138-159) **Energy transfer in a containment vessel.** Walsh, B. (SEA, Inc., Santa Fe, NM (USA)); Ruiz, N.K. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

To evaluate primary and secondary containment of a low-yield nuclear explosion in a large steel containment vessel, the DEWFALL computer program predicts gas pressure and wall temperature histories. The DEWFALL algorithm includes implicit difference equations for radiative and conductive energy transfer, the ANEOS analytic material model, and phase-dependent thermal conductivity models. As the inner layer of wall vaporizes and later recondenses, gross motions of the vapor change the temperature gradients. DEWFALL uses the uniform-pressure approximation to late-time gross motion, which assumes spherical symmetry and small pressure gradients. Time steps are restricted to accommodate sudden changes in specific heat, but may be more than 1000 times larger than tine steps for wave propagation. Comparison with Chart-D calculations reveals no serious problems in DEWFALL. Although usable after an early-time wave propagation calculation, DEWFALL can also make credible energy transfer predictions that start with the introduction of the heat source. The time scale for cooling the vessel interior is sensitive to the optical properties of the liner vapor.

13373 (CONF-8909163–Vol.1, pp. 160-173) **Success-tree methods for assuring reliable containment.** Walsh, B. (SEA, Inc., Santa Fe, NM (USA)); Wheeler, B.H. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Application of risk analysis methods to underground tests clarifies the interrelationship of the various parts of the test bed and the dependence of the total system on the reliability of those parts. In a fault tree analysis of atmospheric release from a typical horizontal line-of-sight (HLOS) test, the dominant source of uncertainty is the earth medium's elastic rebound effect. The probability that this effect fails was estimated by four senior containment consultants; the estimates range over a factor of 2000. Revising the HLOS fault tree into a success tree provides a structure for exploring reliability allocations. Refinement of the stemming-and-closure branches indicates that virtually all of the computed main-drift reliability derives from the formation of a barrier in the rock-matching grout. To isolate and address uncertainties earlier, proposed designs should include reliability requirements for all major subfunctions. For a new test design, analysis verified that allocated reliability requirements would provide at least 97.5% probability of complete containment. Higher reliability would require reduction of the hydrofracturing uncertainties. A revised test design mitigates that threat.

13374 (CONF-8909163–Vol.1, pp. 177-192) **Stemming performance of four similar experiments.** Trent, B.C. (Los Alamos National Lab., NM (USA)); Marusak, N.L. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Radiation records taken from four nuclear tests show very different behavior even though the stemming designs were identical. All four were detonated at the same depth and within 300 horizontal meters of each other. Calculations were performed in order to determine the sensitivity of the process of gas flow to various parameters. The field data and the calculational results are presented and show that the differences may be explained by relatively small variations in the permeability of the fines stemming material.

13375 (CONF-8909163–Vol.1, pp. 193-210) **An optimization approach to stemming design.** Travis, B.J. (Los Alamos National Lab., NM (USA)); Trent, B.C. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

We present a mathematical framework for evaluating the overall effectiveness of a given stemming design. We then solve a system of equations by methods from the calculus of variations to find an optimal design for a given set of general constraints and objective criteria. Typical stemming designs from LANL and LLNL are evaluated and compared to their optimal solutions. Finally, we discuss the limitations of the present model and how it could be improved by incorporating more detailed design criteria.

13376 (CONF-8909163–Vol.1, pp. 211-230) **The effect of cavity gas pressure and porous flow on stemming performance.** Hudson, B. (Lawrence Livermore National Lab., CA (USA)); Trent, B. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

For several years the philosophy of containment science in general and stemming design in particular has been to stop high levels of gas pressure and the associated radiation deep in the hole. The principal reason for this is that containment is not an exact science,

so a factor of safety is achieved by trying to keep the radioactive products generated by the nuclear explosion as far underground as possible. The uncertainty stems from several factors, including the in-situ physical properties of the geologic materials, the specific mechanisms which cause formation of the residual stress field, the extent and nature of faulting, and the influence of water on overall containment. Other factors that are more certain are the location of geologic layers, the placement of the stemming materials and the physical properties of those materials. Lawrence Livermore National Laboratory has taken an aggressive stand with respect to making field measurements of pressure, radiation and ground motion in order to understand the process of gas flow in the stemming after an underground nuclear test. Calculational models at Los Alamos National Laboratory have been applied to this problem to determine the influence of bulk material properties on gas flow and the transport of radioactive contaminants. The purpose of this paper is to show bow the field data may be used to calibrate the models in order to identify likely phenomena taking place underground.

13377 (CONF-8909163–Vol.1, pp. 231-252) **Gas-flow acceptance of a fractured permeable medium.** Nilson, R.H. (S-CUBED, La Jolla, CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The flow of cavity gas into the surrounding permeable medium helps to reduce the threat of gas flow along preferential paths such as natural fractures, hydrofractures, and the stemming column. Seepage from these primary channels into the adjacent wall-rock retards the forward progress of the flow and it also reduces the cavity pressure before and during collapse. A double-porosity model, which incorporates fracture permeability as well as matrix permeability, is used to evaluate the rate of gas flow into a fractured permeable medium, based on prescribed values of measurable parameters which include the large-scale pneumatic diffusivity as well as the permeability and porosity of the matrix material. Since the time-history of the flow rate is qualitatively different for fractured versus homogeneous media, it is not possible to establish a true equivalence between the two classes of media. For this reason, the double-porosity model has been numerically implemented in a relatively simple modular manner which can be used in conjunction with existing hydrofracture codes. The results of example calculations are summarized by comparing the instantaneous flow rate at a representative time of one second. The gas-flow acceptance of fractured volcanic rocks is typically comparable to homogeneous media having the same air-filled porosity and a permeability of 0.1 to 1.0 Darcy. Earlier hydrofracture analyses have suggested that this amount of gas-flow acceptance is marginally sufficient to contain hydrofractures generated by underground nuclear tests which are buried at customary depths, even in very unfavorable circumstances where shock-induced residual stresses are negligible.

13378 (CONF-8909163–Vol.1, pp. 253-280) **Containment of cavity gas in fractured or rubblized emplacement media.** Burkhard, N.R. (Lawrence Livermore National Lab., CA (USA)); Hearst, J.R.; Peterson, E.W.; Nilson, R.H.; Lie, K.H. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

An overview is given of recent research concerning the containment of underground nuclear tests in naturally-fractured or explosively-fractured media. Field experiments have been conducted to evaluate the large-scale pneumatic diffusivity of preshot and postshot media based on a comparison of the surface variation in barometric pressure with downhole measurements of the in situ gas-pressure response. Although an estimate of bulk diffusivity together with core sample data and geologic logs cannot uniquely characterize a fractured permeable medium, it does help to constrain the relationship between fracture density and fracture flow characteristics, making it possible to identify most-probable and worst-case scenarios concerning the containment of cavity gases. Containment of hydrofractures in prefractured rock is being evaluated by a model which accounts for seepage losses into the rock which possesses fracture permeability as well as matrix permeability. Atmospheric pumping of radioactive gases from the chimney to the earth's surface is being investigated by laboratory experiments and numerical calculations; a field experiment is planned and will involve tracer gas injection into a partially collapsed chimney. A few general conclusions are supported by these studies. 1. The importance of fracture permeability is clearly apparent in volcanic rocks, since the large-scale diffusivity is usually orders of magnitude greater than the core sample diffusivity. 2. Chimneys which collapse to the surface are preferable to partially collapsed chimneys, with regard to contaminant transport by atmospheric pumping. 3. A high density of fractures is preferable to one or two isolated fractures because a multiplicity of fractures provides greater gas/rock surface area for cooling, seepage, and molecular diffusion.

13379 (CONF-8909163–Vol.1, pp. 287-312) **The application of a dynamic hydrofracture model to the containment of the Misty Echo cavity event.** Rimer, N. (S-CUBED, La Jolla, CA (USA)); Nilson, R.; Halda, E. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The unusual nature of the MISTY ECHO event, detonated in a large hemispherical cavity, required extensive preshot containment analyses. These analyses, which included nonlinear, axisymmetric two-dimensional finite difference calculations of the event induced ground motions and the potential for dynamic hydrofracture from the cavity, are summarized here. A new computational algorithm, known as F-CUBED, for Fast Fluid Fracture was developed specifically for the containment analyses of this event. F-CUBED couples the Lagrangian ground motion code, CRAM, at every cycle of the calculations. to the FAST code which contains realistic descriptions of the fluid behavior in the fracture or set of fractures, including fluid friction, heat transfer, and seepage. The preshot calculations strongly support the conclusion that the lightly decoupled MISTY ECHO event is very much like an over-buried tamped event. Strong compressive residual stress fields are calculated in the tuff surrounding the nearly spherical expanded MISTY ECHO cavity even in the presence of a weaker, partially zeolitized, tuff layer located only 58 m above the WP. This weak layer is calculated to significantly enhance the extent of cavity gas-filled fractures. However, the conservative calculations show these fractures to be confined to within a cavity radius of the cavity wall. MISTY ECHO has been detonated and was successfully contained. Ground motion measurements are in good agreement with the preshot calculations. The calculations will be compared with reentry observations of cavity dimensions and hydrofracture extent when these become available.

13380 (CONF-8909163–Vol.1, pp. 313-334) **Containment implications of inelastic rock deformation occurring during hydrofracture growth.** Nilson, R. (S-CUBED, La Jolla, CA (USA)); Rimer, N.; Halda, E. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Inelastic rock deformation has two primary effects on the mechanics of hydrofracture. First, the yielding of the rock tends to reduce the transmission of shear forces so that the pressure forces applied to the crack faces are less effective in wedging the crack-tip open. This effect delays fracture initiation and it may help to reduce fracture extent. However, the second primary effect of the inelastic deformation is an increase in the fracture opening displacement which may be tenfold greater than elastic models would predict. This increase in aperture favors the extension of the fracture because it reduces the frictional pressure drop along the fracture and it leaves a wide flow channel which may be difficult to close during rebound. These differences between elastic and inelastic fracture growth are illustrated by numerical calculations which are representative of some past nuclear tests. Comparisons

are made between the predictions of two codes, FAST (Fracturing and Simultaneous Transport) which assumes quasistatic elastic deformation and F-CUBED (Fast Fluid Fracture) which includes a realistic model of the nonlinear rock dynamics.

13381 (CONF-8909163–Vol.1, pp. 335-354) **Choking limitations on the speed of gas-driven fractures.** Griffiths, S.K. (Sandia National Labs., Livermore, CA (USA)); Nilson, R.H. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The gas flow which enters the mouth of a hydrofracture must be accelerated from its stagnant state in the cavity to a state of motion at the crack inlet. This isentropic acceleration causes a reduction of the inlet pressure which may substantially reduce the speed of fracture propagation because it reduces both the fracture opening displacement and the pressure gradient which is available to overcome friction in the crack. To appreciate the possible magnitude of this pressure reduction. consider the case of a crack growing at a speed of 600 m/s which corresponds to the solid-dynamic limitation of roughly half the shear-wave speed. A gas moving at this speed with a temperature of 2000°K would have a Mach number of about M = 0.8 which corresponds to a pressure which is only 65% of the stagnation pressure in the cavity. The gas velocity at the inlet to the crack cannot exceed the speed of sound. However, once inside the crack, the gas can be accelerated to supersonic speeds by the time-wise spreading of the crack walls. Although it is possible to have supersonic conditions everywhere along the crack, a shock usually forms along the midsection of the crack producing subsonic conditions in the front of the crack. These features of gas-driven fracture propagation are illustrated by self-similar solutions for constant-velocity crack propagation in an elastic material. The crack speed may be limited either by fluid-dynamic effects, including choking at the fracture inlet, or solid-dynamic effects such as wave speed considerations. Examples are presented to illustrate the importance of these considerations, both during early-time dynamic fracturing and during late-time long-range fracture extension.

13382 (CONF-8909163–Vol.1, pp. 355-367) **Dynamic properties of DSRM-2 grout.** Fogel, M. (SAIC/Pacifica Technology Division, Del Mar, CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Grouts used in the stemming plan of an underground nuclear test are expected to perform specific tasks and their properties are tailored to assure that performance. Numerical models, based on the expected response of these materials, are used in the design calculations for the stemming column. The accuracy of these calculations rests on the degree to which the numerical models used represent the material response. This paper examines the behavior of a widely used rock matching grout, DSRM-2, in the light of experimental data taken at a variety of strain rates. In an effort to quantify the response of DSRM-2 grout, and to provide data for the construction of material models used in the calculations, quasistatic and high explosive tests have been performed. The static test data are reviewed, and a model based on them is constructed. This model is used in simulations of two high explosive experiments; Sandia's BLOCKSHOT and SRI's small scale laboratory shots. Comparisons of the calculated and measured response are presented. Possible sources for the disagreement are explored, and models that show better agreement with the dynamic data are given.

13383 (CONF-8909163–Vol.1, pp. 368-383) **Characterization of shock conditioned tuff.** Torres, G.; Tester, V.J.; Green, S.J.; LaComb, J.W. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

The characterization of tuff stressed in an underground nuclear has been an ongoing study since the two-in-one concept was first investigated in the early seventies. This paper presents data gathered on the physical properties, ultrasonic velocities, mechanical properties, and microstructures (as characterized using the scanning electron microscope) for pristine and preshocked NTS tuffs. Included are recent tests and a review of old data to identify and verify trends.

13384 (CONF-8909163–Vol.1, pp. 384-394) **In-situ permeability measurements, and the gas flow diagnostic design for the Ledoux event.** Lowry, B. (Science and Engineering Associates, Inc., Santa Fe, NM (USA)); Dunn, S.D.; Keller, C. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Because of the unique containment design of the Los Alamos LEDOUX event, preshot gas flow calculations were performed to predict the pressure profiles and flow magnitudes. Simulations were conducted of the flow due to the noncondensable gas generated by device detonation. Very little permeability data existed that was relevant to the LEDOUX setting. A permeability measurement system was designed specifically for the alluvium environment, utilizing a concept developed in prior tests for the nearby U1c shaft. Compressed air was injected at the end of a packed-off drill hole, and the pressure a known distance from the air injection point measured to infer an effective permeability. Thirteen measurements were, conducted adjacent to the horizontal drift 293 m beneath the surface, and thirteen more in the lower half of the vertical shaft connecting the drift to the surface. The drift permeability data ranged from 0.02 to 3.0 darcys, with the lowest measurements at the drift level and higher values above and below. Shaft measurements, at depths from 143 m to 297 m, ranged from 0.18 to 19 darcys. Again, the lowest values were recorded near the drift elevation. Pressure measurements were installed in several of the drift permeability measurement holes as well as in the zero room and diagnostic drifts to record gas pressures due to device detonation. These measurement designs are described, but due to delays in the event execution no data is available at the time of report preparation.

13385 (CONF-8909163–Vol.2, pp. 3-13) **Application of an effective stress model to underground nuclear explosions.** Swift, R.P. (Lawrence Livermore National Lab., CA (USA)); Attia, A.M. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Most numerical simulations for assessing the containment of underground nuclear explosions are based on total stress constitutive models, where the porous rock-fluid material is represented as a homogeneous mixture using a single equation of state. However, many work point regions are at or near a state of total saturation, hence, a possibility exists that pore pressure can have an effect on containment behavior. To examine the importance of water and its interaction with a porous rock matrix, an effective stress constitutive model has been developed and implemented into the finite element code DYNA2D. In this model, the constituents of a rock-fluid mixture are represented with separate equations of state and combined with an effective stress response law to account for the interaction of the porous matrix with its contained fluid. Numerical simulations of an underground nuclear explosion in a uniform carbonate geology are performed with the effective stress model and compared to that obtained from a total stress representation. The results show that the interaction of fluid and rock accounted for in the effective stress model significantly alters the residual stress field and tensile damage region from the classical conditions given by a total stress model.

13386 (CONF-8909163–Vol.2, pp. 14-21) **Residual stresses calculated using an effective stress model.** Attia, A.V. (Lawrence Livermore National Lab., CA (USA)); Swift, R.P. Lawrence Livermore National Lab., CA (USA). [1989]. From 5.

symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The effect of water content in saturated porous rocks is of interest in assessing the transient rock response to underground nuclear explosions. The interaction of the water-filled pores with the rock matrix is represented in an effective stress constitutive model. Separate equations of state are used for the rock and the water. The effective stress governs the failure response of the rock. Effect of water drainage is assumed to be negligible during early transient response to shock loading of interest. For comparison, a simpler constitutive model is also described. This model represents the saturated porous rock as a homogeneous mixture, using a single equation of state. The associated total homogeneous stress governs the failure response. These models have been incorporated into the 2D explicit finite-element code DYNA-2D. Stress fields around the explosively generated cavity are calculated for a particular event using the Effective Stress and the Total (homogeneous) Stress models, and results are discussed.

13387 (CONF-8909163–Vol.2, pp. 22-49) **Sensitivity of the residual stress field to variation of the strengths for a weak layer overlaying a strong working point layer.** Glenn, H.D.; Rambo, J.T. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

A parameter study using the two-dimensional TENSOR code examines the sensitivity of the residual stress field around the cavity created by an underground nuclear explosion when the shear strengths were varied for: a strong layer containing the WP and a weaker overlaying layer. The baseline calculation used materials similar to those encountered in Area 20 of the Nevada Test Site (NTS). To provide a quantitative basis for comparing the effect of the calculated residual stress fields, a product factor is introduced that combines the magnitude and thickness of the residual stress field relative to cavity size and pressure. This product factor is useful in parameter studies for comparing levels of residual stress field, and is a supplement to other judgment factors which are considered in calculational site evaluations for containment purpose. Calculational results indicate generally stronger hoop stress along the horizontal than the vertical direction. This reflects the fact the weaker material above the cavity tends to degrade hoop stress in that direction. The magnitude of the hoop stress above the cavity generally increases as the strength of the upper material increases from 2 to 20 MPa. However, the magnitude of the hoop stress decreases, when the strength of working point material increases from 17 to 68 MPa. This is due to the smaller cavity radius and higher resulting cavity pressure in combination with a characteristic lower residual stress in the weak upper material.

13388 (CONF-8909163–Vol.2, pp. 51-64) **Ground motion in a multilayered media: Calculated and experimental results from the Hardin event.** Wheeler, V.E. (Lawrence Livermore National Lab., CA (USA)); Rambo, J.T. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

HARDIN was fired on Pahute Mesa. The overburden was formed of intermixed layers of bedded and ashflow tuffs with a single layer of lava. As a continuation of the authors efforts to test calculational models used to predict the effects of underground nuclear explosions, HARDIN was instrumented with ground motion stations both in a satellite hole and the emplacement hole as well as the surface. Preshot and post-shot numerical simulations of HARDIN were performed using the 2-D Tensor code. Presented here are the comparisons between the calculational results using preshot material models and the measured data.

13389 (CONF-8909163–Vol.2, pp. 65) **Prediction of ground motion based on working point medium and overburden lithology.** Burnish, W.M. (Los Alamos National Lab., NM (USA)); Kunkle, T.D. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The two factors that have the clearest effect on ground motion are the scaled depth of burial (SDOB) and the working point (WP) medium. In particular, the saturation of the WP medium seems to have a large effect on the magnitude of the surface motion. Events with working points in saturated tuff have peak velocities a factor of 2 or more higher than events in unsaturated tuff. However, events with working points just above the static water level, i.e., in wet but not fully saturated material, sometimes behave like shots in an unsaturated medium and sometimes like shots fired below the water table. Events in saturated tuff with SDOB less than 135 $m/kt^{1/3}$ often display a focusing effect, having unusually high velocities at surface ground zero that drop off sharply with increased range. Events in unsaturated tuff do not exhibit this behavior, at least not at the SDOB at which one normally operates. This paper investigates what other parameters may affect the ground motion, such as density, water content, and lithology, and whether one can establish better rules for predicting near-field ground motion at the Nevada Test Site.

13390 (CONF-8909163–Vol.2, pp. 69) **Modeling of the Bandicoot event.** App, F.N. (Los Alamos National Lab., NM (USA)); Burnish, W.M. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Using stress-wave calculations with realistic material response properties for alluvium derived from the nearby Merlin Event (U3ct) site, the authors have attempted to shed some light on the conditions that led to the dynamic venting that occurred with execution of the Bandicoot Event (U3bj). Bandicoot is one of the more spectacular examples of an event that should have been contained at its official scaled depth of burial; therefore, its failure has strongly influenced siting criteria for events in alluvium. Until this time, the event has defied modeling because of an inadequate understanding of the response properties of alluvium to ground shock. However, recent advances in modeling alluvium now make such an endeavor meaningful and practical. The study is limited to the calculation of stress and does not address the issue of hydrofracture in the weak stress field about and above the Bandicoot cavity. Nor does it address the influence of the Area 3 fault that traverses surface ground zero. The emphasis of the study is on depth of spall, its influence on the state of residual stress about the Bandicoot cavity, and how this interaction could lead to conditions suitable to the formation of a dynamic vent path. The study also addresses the controversial issue of actual Bandicoot yield.

13391 (CONF-8909163–Vol.2, pp. 70-95) **Modelling of the hearts event.** App, F.N. (Los Alamos National Lab., NM (USA)); Brunish, W.M.; Edwards, C.L. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The ability to calculate stress wave propagation in layered media is relevant to both containment and verification. This study uses HEARTS (U4n) as the subject event for such a calculational exercise. HEARTS is chosen because it is located within a well understood area of the test site known as the Tuff Pile that has the requisite layered stratigraphy and because there is considerable free field motion data available from a nearby satellite hole for verifying the calculated results. The main emphasis is on developing material response models to fit available data, and in the process improve the understanding of the physical mechanisms that shape the observed waveforms. Additionally, two calculations were made of the nearby LOWBALL and CREWLINE events to compare the calculated late-time residual stress fields with the measured microearthquake activity associated with those events. Most of the study is performed using a special Los Alamos version of the SNLA

TOODY stress code. The authors are able to achieve good agreement with most HEARTS motion measurements using fairly uncomplicated material response descriptions. Measured waveforms from near surface ground zero are the most difficult to replicate. There is excellent agreement with measured waveforms away from surface ground zero. The authors find that the surface ground zero and near surface waveforms are most strongly influenced by the properties the authors assign the alluvium and the working point tuff. Intervening materials are not as important. There is good correlation between measured post-shot microquake activity and the calculated residual stress fields for both LOWBALL and CREWLINE.

13392 (CONF-8909163–Vol.2, pp. 96-132) **Modelling of Merlin alluvium.** Brunish, W.M. (Los Alamos National Lab., NM (USA)); App, F.N. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The authors have attempted to learn about the material response of alluvium by modelling the observed ground motion waveforms from the MERLIN event. The MERLIN event has one of the most extensive ground motion arrays for any NTS event, and the data appear to be of uniformly high quality. The MERLIN working point was in alluvium, and the site is homogeneous and uncomplicated. In addition, some mechanical measurements do exist that were performed on reconstituted samples obtained from a nearby exploratory hole. These measurements offer guidance on how to model the strength and compressibility of the alluvium. These results show that this alluvium is indeed very weak material. It was modelled with an unconfined strength of less than 0.1 MPa and a maximum strength of 10 MPa. The crush initiation pressure used was 1.2 MPa followed by a highly compressible crush interval to 30 MPa. These parameters are consistent with the mechanical measurements and gave good agreement with the velocity data. In order to get satisfactory agreement with the waveforms, the authors had to modify the computer code to allow more shear strain during crush than is normally provided in a constant shear modulus treatment. Also, they allowed for the effect of damage on shear strength by reducing the shear failure surface with increased failure-associated shear strain. Other effects that they investigated include anisotropy of in-situ stress and linkage of volumetric and shear strain. The authors feel that they have developed material models that accurately reflect the response properties of alluvium, and tell them something about the in-situ behavior of alluvium.

13393 (CONF-8909163–Vol.2, pp. 133-138) **Recent nuclear cavity pressure measurements.** Hudson, B. (Lawrence Livermore National Lab., CA (USA)); Stubbs, T.; Nilson, R.; Peterson, E. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

An underground nuclear test is typically conducted in an emplacement hole hundreds of metres deep that has been back-filled with sand, gravel, and concrete plugs. These plugs, which vary in thickness and strength, serve not only to prevent radioactive material from reaching the surface but also, ideally, to constrain it to a region near the explosion cavity. When the authors determine the appropriate depth of burial (DOB) for a device, they have to make it shallow enough to be economical but deep enough to reasonably ensure containment given the expected yield of the device and the particular geology of the hole. To do this, the authors have developed sophisticated computer models that consider each site's geologic structure and physical properties to predict explosion effects such as ground motion, confining stresses around the cavity, and cavity pressure. However, to be able to assess the performance and relative accuracy of these computational models, the authors must develop a data base of the measured values for each of these effects that can be compared with predictions. A new scheme was designed to optimize chances of maintaining pressure communication with a nuclear cavity. The essential elements of the new design included a fluid-filled, helically coiled capillary tube and a reservoir containing high pressures (up to 12,000 psi) for blowing the fluid from the tubing after cavity formation. This system has been tested at the Cornucopia, Mission Ghost, and Rhyolite events and results are given.

13394 (CONF-8909163–Vol.2, pp. 160-186) **In-situ equivalent CO_2 estimates using a neutron-induced gamma-ray spectroscopy logging system.** Hearst, J.R. (Lawrence Livermore National Lab., CA (USA)); Conaway, J.G.; Mathews, M.A.; Barber, J.W. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

When a nuclear explosive is tested underground, rock in the immediate vicinity of the explosion is heated to very high temperatures. If any of that rock contains carbonates (dolomite or calcite), these are dissociated and the carbon may combine with oxygen to form carbon dioxide, increasing the hazard of a delayed leak. The authors are trying to adapt a commercial neutron-induced gamma-ray spectroscopy log to estimate carbonate content in emplacement (2- 4-m diameter) boreholes at the Nevada Test Site. The authors have performed large-scale laboratory experiments using test boxes filled with mixtures of silica sand and crushed limestone. These tests showed that the log is sensitive not only to carbonate content but also to water content of the formation as well as the gap between the logging sonde and the wall of the borehole. Consequently, the authors modified the sonde to measure the sonde-wall gap and developed procedures for correcting the measured carbonate content for water content and gap. When the authors used these procedures in the laboratory, the authors obtained an accuracy of better than 0.02 equivalent dry weight fraction CO (the amount of CO_2 that would be generated if all the carbonate were converted to CO_2). Tests in boreholes have shown good qualitative agreement wit the trends in the sample data but generally indicated somewhat higher equivalent CO_2 content. It appears that the corrections developed in the laboratory may result in an overcorrection. Moreover, other minerals present in the field may decrease the accuracy of the measurement. The authors are dealing with these problems though further investigation, which is under way, involving the raw spectral data and through the use of Monte Carlo calculations.

13395 (CONF-8909163–Vol.2, pp. 186-205) **Occurrence, distribution and measurement of carbonate in the alluvium of southern Yucca Flat, Nevada Test Site.** Rayburn, C.J. (Fenix and Scisson of Nevada, Inc., Mercury, NV (USA)); Drellack, S.L. Jr.; Thompson, P.H. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Nuclear detonation produces noncondensable carbon dioxide (CO_2) gas from naturally occurring carbonates in the alluvium. Generation of CO_2 in underground tests has been linked to a significant percentage of past containment failures. The carbonate content of the test medium is therefore an important parameter to the containment scientist, and is routinely measured as weight percent CO_2 of samples collected in emplacement holes. Carbonate content in southern Yucca Flat alluvium varies with geographic location, reflecting differing depositional source areas and distance to these sources. Variation also occurs with stratigraphic position (depth) due to the changing lithology of detritus over time as erosion exposes new material, and also to the effects of depth on diagenetic processes. The value of CO, data obtained through sample analysis is directly dependant upon how accurately the samples represent the test medium. A variety of techniques are used to obtain samples from emplacement holes, and each is subject to inherent limitations which must be understood if data are to be interpreted correctly. Because of these limitations, it is not realistic to treat laboratory CO_2 data independently as a precise measure of carbonate content for a particular depth or interval. Patterns of carbonate content in alluvium are recognizable and correlative, however, and can be used to successfully predict range, variability and mode of occurrence for carbonate content at a given

location. Using this information, the containment scientist can select hole locations and working point positions to avoid potential high CO_2 sources, design an effective sampling program and increase the confidence in a successful test containment.

13396 (CONF-8909163–Vol.2, pp. 274-296) **Carbonate rock emplacement sites at the Nevada test site.** Cogbill, A.H. (Los Alamos National Lab., NM (USA)); Gerety, M.T.; App, F.N.; Hawkins, W.L. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

In the Spring of 1988 Los Alamos National Laboratory began a search to locate an unusual NTS emplacement site. The site must be in carbonate rock, preferably a massive carbonate, beneath the water table; the carbonate unit must be at least 100 m thick. For containment, the carbonate should be overlain by at least 300 m of porous, unsaturated materials such as tuff or alluvium. Finally, the rocks serving as the working point medium must be suitably separated from the main carbonate aquifer that exists throughout much of southeastern Nevada. The last requirement was established to insure that radioactive products of the nuclear detonation would not migrate rapidly into the regional aquifer. The Tippipah Limestone, a limestone exposed in the Syncline Ridge area on the western margin of Yucca Flat, seemed to be the best candidate rock, because where exposed it is usually underlain by the Eleana Formation, a highly impermeable, rather thick, clastic formation. These studies have concentrated on the western margin of Area 4. After examination of the available geological and geophysical information, we acquired new gravity and magnetic data along three roughly west-east traverses, each about 3 km in length. Resistivity data comprising two approximately perpendicular, crossed Schlumberger profiles were acquired, as well. If a significant thickness of the more resistive limestone were present at depths less than 1000 m, the electrical survey should detect it. No resistive units of significant thickness were detected. The implication is that the exposed Tippipah Limestone probably represents an allochthonous geologic unit, and is unlikely to be present in significant thickness beneath the sediments and volcanic units of Yucca Flat. The probability of finding a carbonate rock emplacement site at NTS that meets the criteria above is considered rather small.

13397 (CONF-8909163–Vol.2, pp. 297-309) **An expert system for assisting in geologic site characterization.** Marusak, N.L. (Los Alamos National Lab., NM (USA)); Berkbigler, K.P.; Papcun, G.J. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The Geologist's Assistant is an expert system under development at Los Alamos designed to aid containment scientists with the analysis of geologic and geophysical data obtained from drilled holes at the Nevada Test Site. As more information becomes available, it is imperative that the geoscientist consider all data relevant to a specific site characterization. This expert system is intended to be an interactive tool to help with an initial analysis of a site location using all the available data. Geological and geophysical information from each drilled hole is stored in GEODES, a database management system developed at Los Alamos to retain all the accumulated data. The expert system has on-line access to the GEODES database as required in order to analyze a site. A distinctive feature of the Geologist's Assistant expert system is that it combines symbolic computing in the form of rules with numerical computing in the form of pattern matching techniques. Geologists employ a variety of heuristics when characterizing the subsurface stratigraphy surrounding a hole. These heuristics are implemented as rules in the expert system. Inferencing using the rules guides the direction of the analysis by producing tentative conclusions which are further investigated by applying numerical pattern matching techniques to the appropriate geophysical logs from GEODES. The specific numerical technique used is called dynamic pattern warping. The system is developed using carefully evaluated expert system tools. The implementation is distributed between a VAX where the expert system, pattern matching algorithm, and GEODES database management system reside, and an IBM PC/AT which provides the user interface.

13398 (CONF-8909163–Vol.2, pp. 310-336) **A study of the difference between gravimetric and gamma-gamma density near the surface in northern Yucca Flat.** Hearst, J.R.; Burkhard, N.R. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Although the mean and median of the difference between average density from 50 to 200 m below the surface in 43 holes in northern Yucca Flat computed from a density log and that computed from borehole gravity using the measured free air gradient is very close to zero, the range of values is very large. Many individual values of the difference are significantly different from zero. When the gravimetric density is computed using a free air gradient calculated from the surface gravity on an irregular but approximately 300 m grid, the mean and median of the difference between gravimetric and gamma-gamma density is slightly closer to zero than when the measured free air gradient is used. The range of values is not significantly decreased. Proposed explanations for this large range fall into two categories: anomalies in the gravity field or its horizontal derivative at the sites with a large difference range, causing changes in the free air gradient or the near-surface gravimetric density, and mechanisms that affect the bulk density near the borehole, causing changes in the gamma-gamma density. The authors have investigated many proposed explanations and have found no single mechanism that is consistent with the data. These results indicate that the choice of method of determining free air gradient causes no significant change in the difference between near-surface gamma density and gravimetric density, and that there is no obvious method of eliminating the range. Because calculation from surface gravity is much less expensive than tower measurement, and there is no evidence that it is less accurate, the authors consider it the logical method for routinely obtaining free air gradient until some evidence is found to suggest the contrary. They are attempting to optimize the calculational procedure. The tradeoff is between the accuracy of the calculated free air gradient and the amount of surface gravity data required.

13399 (CONF-8909163–Vol.2, pp. 337-354) **Distortion of geophysical logs near bed boundaries and in complex lithologies.** Conaway, J.G. (Los Alamos National Lab., NM (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

A properly calibrated geophysical logging sonde or toot can give accurate formation physical property estimates in borehole regions where those properties are uniform or slowly varying. However, in general, the logs will be distorted in the vicinity of bed boundaries or in complex lithologies. Thin zones in particular give rise to logs which in some cases can be very inaccurate, even to the extent of indicating a decrease in some physical property when an increase was actually the case. This paper presents a discussion of the theoretical responses of several NTS logging tools under such conditions.

13400 (CONF-8909163–Vol.2, pp. 355-371) **Computerized tomography as a geoscience tool.** Torres, G. (Terra Tek Research, Salt Lake City, UT (USA)); Tester, V.J.; Sharer, J.; LaComb, J.W. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The purpose of utilizing computerized tomography was to evaluate the potential for change in saturation of NTS tuff during coring operations. This was addressed by characterizing the migration of fluids (primarily water) into and out of tuff specimens from the Nevada Test Site. Several drying tests and fluid intrusion tests were conducted at ambient conditions over a 48 hour period. Each

test was monitored with the CT-scanner and density profiles created to show fluid movement.

13401 (CONF-8909163–Vol.2, pp. 372-384) **A statistical analysis of grain density measurements from cuttings and percussion gun samples.** Pawloski, G.A. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Statistical tests on 113 pairs of grain density measurements show that the grain densities from cuttings samples are different from those measured on gun samples. The difference of the means of the two samples types is 0.02 Mg/m^3, which is small. When stratigraphic subsets were tested, grain densities from cuttings samples could not be distinguished from those of gun samples for the Rainier Mesa Member and the Tunnel Beds. The measurements on the two sample types could be distinguished for the Paintbrush Tuff and the induced zone (Wahmonie Formation). The differences of the means of the two sample types are again small. Testing of lithologic subsets also indicates that grain density measurements from cuttings can be distinguished from those of gun samples. Again, the differences of the means are small. For containment applications, grain density measurements from cuttings and gun samples are virtually identical when measurement accuracy is taken into consideration. Thus, grain densities from cuttings samples are adequate for calculating physical properties.

13402 (CONF-8909163–Vol.2, pp. 387) **Revised volcanic stratigraphy of the southwestern Nevada volcanic field.** Warren, R.G. (Los Alamos National Lab., NM (USA)); Sawyer, D.A.; Covington, H.R. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

All principal and proposed areas for testing of nuclear weapons at the Nevada Test Site (NTS) are underlain by 6 to 16 Ma old volcanic units of the southwestern Nevada volcanic field (SWNVF). Detailed petrologic studies have clarified several stratigraphic problems. Also, petrographic and chemical characterization of nonwelded tuffs regionally has established a comprehensive correlation of units between the principal testing areas. The authors propose a revised volcanic stratigraphy for the SWNVF. They arrange all volcanic units of the SWNVF into 10 major assemblages, each symbolized with a unique second letter. Each assemblage consists of units with petrologic characteristics readily distinguishable from units of assemblages above and below. Each unit represents eruption of a batch of magma significantly evolved from or unrelated to the next older unit and thus provides a very restricted but not necessarily geologically instantaneous stratigraphic datum. Unit symbols are designated by a unique third letter. Variations in eruption mechanics may result in lithologic or petrographic variations within each batch of magma which may be locally mappable as lithologic or petrologic subunits. Symbols for each subunit are designated by a unique fourth letter. The proposed revised stratigraphy of the SWNVF offers several advantages for containment evaluation: (1) direct relation of stratigraphic experience among all test areas and user agencies; (2) a systematic and formal symbology for easier computer management of containment experience relative to stratigraphy; (3) less burdensome nomenclature consistent with current NTS usage; (4) the hierarchy of units and symbols serves as guide for further research into causes for temporal and spatial petrologic variations within the SWNVF.

13403 (CONF-8909163–Vol.2, pp. 388-404) **Geology of the U-1a.01 horizontal drift complex, southwestern Yucca Flat, Nevada test site.** Drellack, S.L. Jr. (Fenix and Scisson of Nevada, Inc., Mercury (USA)); Thompson, P.H.; Rayburn, C.J. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The U-1a.01 complex is comprised of the U-1a shaft, two large-diameter cable access holes, and approximately 229m of horizontal drift mined within unsaturated Quaternary alluvium 292.6m below the surface. Geologic mapping and related work afforded a unique opportunity to observe and evaluate the characteristics of alluvium in the subsurface of Yucca Flat, and to compare the results with surface and drill hole alluvium data. A program of mapping, sampling and photography was carried out while mining was in progress, with the dual purpose of characterizing the geology of the site and documenting the mining operation. The geology observed at the U-1a.01 complex is consistent with present understanding of the geologic character and alluvial deposition of southwestern Yucca Flat. The complex is situated in an alluvium-filled, north-south trending structural basin bounded on the west by a fault scarp and on the east by west-dipping Tertiary volcanic rocks. The alluvium at the drift level is comprised of poorly sorted detritus from Paleozoic sediments and Tertiary volcanic rocks, deposited as coalescing fans debouching from higher terrain to the west. Deposition was intermittent and localized, forming highly discontinuous, poorly stratified deposits. Bedding and diagenetic features are typical of those observed in contemporary alluvial fan deposits. Gentle southwesterly dips in the alluvium bedding are believed to reflect post-depositional westward rotation of the basin block. Two small faults mapped in the drift probably are related to this structural adjustment. Tests performed on in-situ alluvium and drift samples provided information about the physical properties of the alluvium and aided in the site characterization. Work at U-1a.01 was supported by the United States Department of Energy.

13404 (CONF-8909163–Vol.2, pp. 405-416) **The Delamar fracture zone: Recognition of unmapped zones of weakness on Pahute Mesa, Nevada Test Site.** Covington, H.R. (Geological Survey, Mercury, NV (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The Delamar underground nuclear test, conducted at Pahute Mesa, Nevada Test Site, formed extensive fracture zones. The orientation, extent (more than 500 m north and south of surface ground zero), and linear distribution of the fractures suggest the presence of two pre-existing zones of weakness. Because these zones had not been identified prior to the test, studies were initiated to determine the nature of these zones and to define methods to identify similar zones in the future. The methods selected to characterize the fracture zones were (1) mapping surface effects on low-altitude aerial photographs, (2) trenching, (3) exploratory drilling, and (4) surface magnetic surveys. Preliminary results of these investigations show that the two fracture zones occurred along preexisting zones of weakness. The studies also determined that previously unrecognized zones of weakness may be identified using surface mapping techniques. The primary surface features that can be used in the recognition of such zones are (1) a linear feature or an albedo change across a linear feature, on aerial photographs, (2) a linear break between areas of very little and abundant caliche clasts in the surface soil, (3) a linear disruption of rock varnish, and (4) a linear distribution of chalcedony clasts in the surface soil. The recognition of these zones of weakness during predrill field investigation at future sites will allow an early assessment of the possible impact of these structures on containment, and provide data for possible relocation of the site.

4504 Nuclear and Radiological Warfare

13405 (LA–11959-MS) **Analytic optimizations in crisis stability.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 29p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91008483. Source: OSTI; NTIS; GPO Dep.

Second strikes are dominated by submarine launched missiles in the absence of defenses, but shift to aircraft at modest levels of defense. Defenses protect some retaliatory missiles, but not enough to retaliate strongly. With defenses, missiles should be vestigial and could be eliminated without penalty. Then aircraft could also be

significantly reduced without impacting stability. The combination of parameters that maximizes cost effectiveness also maximizes midcourse effectiveness and crisis stability. 15 refs., 20 figs.

4505 Strategic Defense Initiative

13406 (LA–11773-MS) **Neutral particle beam discrimination and lethality.** Canavan, G.H.; Browne, J.C. Los Alamos National Lab., NM (USA). Mar 1991. 12p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91009009. Source: OSTI; NTIS; GPO Dep.

Using, or possibly just developing, neutral particle beams (NPBs) to both discriminate decoys and kill weapons could induce 10-fold reductions in each. The conventional "factor of two" increase in the time required to do both does not capture particle beams' impact. They could reduce the threat to ≈1 reentry vehicle (RV) plus ≈10 decoys per heavy missile, which could be defeated at a 10-100:1 cost effectiveness ratio by current interceptors. 8 refs., 2 figs.

13407 (LA–11781-MS) **Requirements for progressive strategic defenses.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 42p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91008997. Source: OSTI; NTIS; GPO Dep.

Space-based layers face counter-measures, cost, and survivability concerns. Midcourse defenses face decoys, which they must discriminate. Simple models indicate that their initial deployment should be effective and that development could improve their effectiveness. That would provide a hedge against uncertainty and an incentive to the reduction of offensive forces. 49 refs., 6 figs.

13408 (LA–11825-MS) **Threat modernization in the near term.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91009228. Source: OSTI; NTIS; GPO Dep.

The continuing effectiveness of space-based interceptors (SBIs) depends critically on the threat modernization rate. Fast-burn missiles could degrade their effectiveness by ≈50%; early deployment of weapons and decoys could degrade it by a like factor, as could reducing the launch area or mobile missile. Together, these factors would reduce SBI availability a factor of ≈20 and degrade effectiveness. The result could be a SBI defense that cost as much as the offense. 17 refs.

13409 (LA–11829-MS) **Discrimination options in the near term.** Canavan, G.H.; Browne, J.C. Los Alamos National Lab., NM (USA). Mar 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009000. Source: OSTI; NTIS; GPO Dep.

This article estimates the sizes of midcourse threats for various boost-phase defensive layers, derives the optimal number of decoys for the offense to use against specified defenses, and discusses the impact of various levels of discrimination on them, which produces an integrated picture of the trades between boost-phase attrition, midcourse defenses, and discrimination. 17 refs., 11 figs.

13410 (LA–11830-MS) **Strategic defense requirements for progressive applications.** Canavan, G.H.; Browne, J.C. Los Alamos National Lab., NM (USA). Mar 1991. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009045. Source: OSTI; NTIS; GPO Dep.

A companion paper discusses various applications for which strategic defense concepts could be used. The applications form a progression in size and complexity from accidental or unauthorized launches, through third country or subnational threats, to limited or strategic exchanges. This report attempts to quantify the requirements for meeting those applications and to assess the maturity of current strategic defense concepts relative to them, concluding that there are adequate interceptors for all of them, but that sensitivities to uncertainties in discrimination are awkward at all levels and bothersome at the high end. Strategic defenses are applicable to a progression of threats that range from accidental or unauthorized launches, through third country or subnational threats, to limited or strategic exchanges. Technologies exist for long range launches, but launches close to shore are feasible, stressing, and favor the attacker. Space based interceptors are suited to meeting the bulk of the launches; directed energy has significant advantages in reducing the threat to manageable levels. Current interceptor concepts appear adequate, but discrimination is both pivotal and delayed. 38 refs., 10 figs.

13411 (LA–11847-MS) **Notes on space, satellites, and survivability.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 14p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91009229. Source: OSTI; NTIS; GPO Dep.

The satellites most at risk in the near term are sensors and the brilliant pebbles for boost-phase defense. The availability of countermeasures for kinetic energy anti-satellites (ASATs) tends to downgrade them. Space-based interceptors and lasers are even less effective. Space mines appear to be the dominant space-based threat. Their main advantages are simplicity and low mass. If they can be forced to use decoys or cannot discriminate, that advantage is lost. For fundamental reasons discrimination should become more robust in time and combined defenses should become more effective. 12 refs.

13412 (LA–11859-MS) **Near-term boost-phase defense sensitivities.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 34p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91008999. Source: OSTI; NTIS; GPO Dep.

Boost-phase defenses are sensitive to offensive and defensive parameters. For distributed silos and mobile heavy missiles, about 25% of the weapons should penetrate the boost phase, which would require midcourse defenses. Concentration of heavy mobiles before launch would not impact that. Single-missile mobiles are less attractive targets and should penetrate near-term defenses, but second waves of fixed or compact mobile heavy missiles would be overwhelmed. For nominal costs and performance, combined defenses have adequate margin, but degraded space-based interceptor (SBI) performance or increased sensor costs would eliminate it. Discrimination could keep costs in balance while defending useful numbers of targets. 26 refs., 18 figs.

13413 (LA–11920-MS) **Interaction of strategic defenses with crisis stability: Part 3, Summary and conclusions.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 26p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91008480. Source: OSTI; NTIS; GPO Dep.

Retaliatory deterrence is now carried primarily by SLBMs. START would shift that toward aircraft. Moderate defenses would shift retaliation strongly toward aircraft. Combined boost- and midcourse defenses would increase stability. Mutual reductions of heavy ICBMs have little impact in the absence of defenses. It appears preferable to defend current missiles in place. Unilateral deployments of defense leave crisis indices unchanged while reducing the number of weapons delivered. One-sided reductions in conjunction with defenses produce intermediate indices. Interactive reduction of defense suppression could reduce penetration to marginal levels. Coupling between second strike and target set could be resolved by altering objectives or the target set. 13 refs., 6 figs.

13414 (LA–11974-MS) **Crisis stability indices for adaptive two-layer defenses.** Canavan, G.H. Los Alamos National Lab., NM (USA). Mar 1991. 32p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91008481. Source: OSTI; NTIS; GPO Dep.

This note derives a simple, approximate model that contains most of the features needed to understand the variation of crisis stability indices with defenses. Boost-phase defenses are subtractive; midcourse defenses are preferential and adaptive. Defenses protect some retaliatory missiles, but not enough to retaliate strongly. Missile restrikes penetrate poorly, so most of the first and second strikes are carried by aircraft, which makes discussion of factors that might reduce their pre-launch survivability important. 22 refs., 19 figs.

13415 (LA–12013-MS) **Background issues for defensive interceptors.** Canavan, G.H. Los Alamos National Lab., NM (USA).

Mar 1991. 10p. Sponsored by USDOE, Washin. DOE Contract W-7405-ENG-36. Order Number DE91009219. Source: OSTI; NTIS; GPO Dep.

Mean nuclear backgrounds are large, but are arguably amenable to frame-to-frame subtraction. Striated backgrounds on the sensors for defensive interceptors could, however, cause clutter leak-through, which could make detection and track difficult. Nominal motions and backgrounds give signal to clutter ratios too low to be useful. Clutter leakage due to line-of-sight drift can be reduced by stabilizing the line of sight around the background clutter itself. Current interceptors have detector arrays large enough for operation independent of nuclear backgrounds in their fields of view. 6 refs., 2 figs.

13416 (SAND–86-2742) **Models for multimegawatt space power systems.** Edenburn, M.W. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 104p. Sponsored by US-DOE, Wash. DOE Contract AC04-76DP00789. Order Number DE91008008. Source: OSTI; NTIS; GPO Dep.

This report describes models for multimegawatt, space power systems which Sandia's Advanced Power Systems Division has constructed to help evaluate space power systems for SDI's Space Power Office. Five system models and models for associated components are presented for both open (power system waste products are exhausted into space) and closed (no waste products) systems: open, burst mode, hydrogen cooled nuclear reactor – turboalternator system; open, hydrogen-oxygen combustion turboalternator system; closed, nuclear reactor powered Brayton cycle system; closed, liquid metal Rankine cycle system; and closed, in-core, reactor therminonic system. The models estimate performance and mass for the components in each of these systems. 17 refs., 8 figs., 15 tabs.

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Refer also to citation(s) 12872, 13882, 13884, 13929, 13930

13417 (FAW-TR–90010) **AI and model management: FAW research in environmental information systems.** Radermacher, F.J. Ulm Univ. (Germany, F.R.). Forschungsinstitut fuer Anwendungsorientierte Wissensverarbeitung (FAW). 28 May 1990. 10p. (CONF-9009359–1: 5. symposium: Computer science for environmental protection, Vienna (Austria), 19-21 Sep 1990). Order Number DE91756456. Source: OSTI; NTIS (US Sales Only).

The paper gives a short overview of work done at the Research Institute for Application-Oriented Knowledge Processing (FAW) in Ulm, with particular emphasis on applications in the field of environmental information systems. The basic research approach followed at the FAW is one that views intelligent systems as model-oriented and model-driven. Integrating models and using operators in models is seen as the dominate paradigm for competent systems in general. The paper briefly describes the structure of the FAW, discusses to some extent the connection between artificial intelligence and modelling and, finally, describes some of the projects that the institute, together with the State of Baden-Wuerttemberg and some industrial partners, is developing for use within the Baden-Wuerttemberg environmental information system. These projects deal with fundamental questions in building such systems, with knowledge extraction from sensor images, with water analysis, the natural-language access to databases and, finally, the knowledge-based access to distributed, heterogeneous databases. (orig.).

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Refer also to citation(s) 12375, 12392, 12413, 12415, 12424, 12519, 12536, 12556, 12587, 12644, 12646, 12647, 12653, 12847, 13010, 13145, 13149, 13171, 13322, 13456, 13484, 13507, 13517, 13553, 13569, 13575

13418 (CONF-910575–1) **Using climate model output to assess the impacts of climate change on water resources.** Cushman, R.M. Oak Ridge National Lab., TN (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. national conference on water resources planning and management; New Orleans, LA (USA); 20-22 May 1991. Order Number DE91004542. Source: OSTI; NTIS; GPO Dep.

The use of general circulation models (GCMs) to provide climate data for regional assessments of the impacts of changing climate on water resources stretches the limits of what the models were designed for. Problems that must be addressed include disagreement on a regional scale among GCMs and between the modeled and observed climate; coarse spatial resolution of the models; and simplistic representation of surface hydrology. It is important that continued progress be made in developing the methodology for using GCM output in climate-impact assessments. 18 refs.

13419 (DOE/CH/10432–1) **Environmental consequences of energy production: Proceedings.** Illinois Univ., Chicago, IL (USA). Energy Resources Center. [1989]. 199p. Sponsored by US-DOE, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA). DOE Contract FG02-89CH10432. (CONF-8910395–: 17. annual Illinois energy conference: environmental consequences of energy production, Chicago, IL (USA), 19-20 Oct 1989). Order Number DE91009140. Source: OSTI; NTIS; GPO Dep.

The Seventeenth Annual Illinois Energy conference entitled Environmental consequences of Energy Production was held in Chicago, Illinois on October 19-20, 1989. The purpose of the meeting was to provide a forum for exchange of information on the technical, economic and institutional issues surrounding energy production and related environmental problems. The conference program was developed by a planning committee which included Illinois energy and environmental specialists from the major sectors including energy industries, environmental organizations, research universities, utility companies, federal, state and local government agencies, and public interest groups. The conference included presentations on four major topic areas. The issue areas were: urban pollution: where are we now and what needs to be done in the future; the acid rain problem: implications of proposed federal legislation on the Midwest; global warming: an update on the scientific debate; and strategies to minimize environmental damage. Separate abstracts have been prepared for the individual presentations. (FL)

13420 (DOE/EA–0492) **Kauai Test Facility two experiment rocket campaign: Environmental Assessment, Sandia National Laboratories, Albuquerque, New Mexico.** USDOE Albuquerque Operations Office, NM (USA). [1991]. 38p. Sponsored by USDOE,. Order Number DE91008894. Source: OSTI; NTIS; GPO Dep.

The Kauai Test Facility (KTF) is a Department of Energy (DOE) owned facility located at Barking Sands, on the west coast of the island of Kauai, Hawaii. The KTF has a rocket preparation and launching capability for both rail-launched and vertical-launched capability for both rail-launched and vertical-launched rockets. Launches primarily support high altitude scientific research and re-entry vehicle systems and carry experimental non-nuclear payloads. This environmental assessment (EA) has been prepared for the Two Experiment Rocket Campaign, during which the STRYPI/LACE (STRYPI is not an acronym – its the name of the rocket; LACE is the acronym for Low Altitude Compensation Experiment) and the RAP-501 (Rocket Accelerated Penetration) will be flown in conjunction from the KTF in February 1991 to reduce costs. There have been numerous rocket campaigns at the KTF in prior years that have used the same motors to be used in the current two experiment rocket campaign. The main difference noted in this environmental documentation is that the two rockets have not previously been flown in conjunction. Previous National Environmental Policy Act (NEPA) approvals of launches using these motors were limited to different and separate campaigns with diverse sources of funding. 2 figs., 5 tabs.

13421 (DOE/ER/61014–1) **Cloud and ocean effects on global greenhouse warming: Progress report, 15 July 1990–14 January 1991.** Hoffert, M.I. New York Univ., NY (USA). Dept. of Applied Science. Feb 1991. 4p. Sponsored by USDOE,. DOE Contract FG02-90ER61014. Order Number DE91008842. Source: OSTI; NTIS; GPO Dep.

Six months into the above-referenced grant, we are making good progress on our research plan. We intend to develop a new generation of transient climate/ocean model capable of reflecting feedbacks associated with clouds and ocean dynamics, and to use them to better constrain the transient climate response to increased greenhouse gas concentrations in the atmosphere. This is a necessary step in quantifying the links between radiative forcing of the atmosphere and climate response on 10–100 year time scales. The modelling work involves, on the one hand, developing a better characterization of cloud forcing and feedback, and on the other, a new generation of ocean/climate model incorporating feedbacks from the changing stratification of the ocean as heat is absorbed during periods of global warming. 3 figs.

13422 (EML–532) **Improved gas chromatographic electron-capture analysis using a pulse frequency method.** Latner, N.; Lagomarsino, R.J. USDOE Environmental Measurements Lab., New York, NY (USA). Feb 1991. 14p. Sponsored by USDOE,. Order Number DE91008425. Source: OSTI; NTIS; GPO Dep.

A method was developed to extend the dynamic output range of the Varian 3700 Gas Chromatograph (GC) and to improve its ability to analyze samples that simultaneously exhibit high and low quantities of gas tracers. A series of tests were run, using three different tracers, to compare the results obtained by this pulse frequency method to those using the normal analog voltage output. These tests demonstrated good agreement over the four-decade range of interest. Clearly, the pulse frequency system has proven to be an effective tool for extending the ability of the Varian 3700 GC in the measurement of tracer samples showing mixed high and low concentration peaks. 5 refs., 5 figs.

13423 (EML–535) **Semi-annual report of the Department of Energy, Deputy Assistant Secretary for Environment, Quality Assessment Program.** Sanderson, C.G.; Scarpitta, S.C. USDOE Environmental Measurements Lab., New York, NY (USA). 2 Jan 1991. 99p. Sponsored by USDOE,. Order Number DE91008422. Source: OSTI; NTIS; GPO Dep.

This report presents the results from the analysis of the 33rd set of environmental quality assessment samples (QAP 33) that were received on or before December 4, 1990. This Quality Assessment Program (QAP) is designed to test the quality of the environmental measurements being reported to the Department of Energy by its contractors. Since 1976, real or synthetic environmental samples that have been prepared and thoroughly analyzed at the Environmental Measurements Laboratory (EML) have been distributed at first quarterly and then semi-annually to these contractors. Their results, which are returned to EML within 90 days, are compiled with EML's results and are reported back to the participating contractors 30 days later. A summary of the reported results is available to the participants 3 days after the reporting deadline via a modem-telephone connection to the EML computer. The data for the different kinds of samples are given in the following units: air filters in Bq/filter; soil in Bq kg^{-1}; tissue in Bq kg^{-1}; vegetation in Bq kg^{-1}; and water in Bq L^{-1}. The values for elemental uranium are reported in μg/filter, g, or mL. The 'EML value' listed in the tables to which the contractors' results are compared is the mean of replicate demonstrations for each nuclide. The EML uncertainty is the standard error of the mean. All other uncertainties are as reported by the participants.

13424 (ENEA-RT-DISP–90-01) **Improved sequential puff model for atmospheric dispersion evaluation (SPADE).** Desiato, F. ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria. 1990. 45p. (RT/DISP–90-01). Order Number DE91752925. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the improved version of the Sequential Puff for Atmospheric Dispersion Evaluation model (SPADE), developed at ENEA-DISP (Italian Nuclear Safety and Health Protection Directorate) as a component of ARIES (Atmospheric Release Impact Evaluation System). SPADE was originally designed for the real time assessment of the consequences of a nuclear release into the atmosphere, but it is also suited for sensitivity studies, investigations, or routine applications. It can estimate ground-level air concentrations, deposition and cloud gamma dose rate in flat or gently rolling terrain in the vicinity of a point source. Recently, several aspects of the modelling of dispersion processes have been improved, and new modules have been implemented in SPADE. In the first part of the report, a general description of the model is given, and the assumptions and parameterizations used to simulate the main physical processes are described. The second part deals with the structure of the computer code and of input and output files, and can be regarded as a user's guide to the model.

13425 (ETDE-mf–1756252) **Atmospheric boundary layer in a mountain valley during katabatic wind and valley breeze.** Wissenschaftliche Mitteilungen des Meteorologischen Instituts der Universitaet Muenchen. Freytag, C. Muenchen Univ. (Germany, F.R.). Meteorologisches Inst. Jun 1988 211p. (In German). Order Number DE91756252. Source: OSTI; NTIS (US Sales Only).

This work is an attempt to investigate physical relationships during katabatic wind and valley breeze in a large Alpine valley. Being experimental in character, the work is oriented to measuring results. From measurements along the axis of the valley and in the adjacent medium-range mountains, as they were carried out during the MERKUR experiment, the budgets of mass, energy, and impulse for individual areas of the valley atmosphere could be calculated. These budgets serve as basic data for investigating the circulation, energetics, and dynamics of the mountain wind system. The introductory paragraphs give a brief overview on the state of research and open questions. The description of the experiment and of the courses of katabatic wind and valley breeze during the case study make up the second part of the work. The main part comprises the setting down of budget equations and the demonstration of the time curve and spatial structure of the individual terms. The questions raised are then discussed in the light of the author's measurements and other authors' results. Conclusions from the budget analyses are completed by simple model calculations. (orig.).

13426 (ETDE-mf–1756440) **Results of aerological and near-ground ozone measurements in the second half of 1989.** Sonderbeobachtungen des Meteorologischen Observatoriums Hohenpeissenberg. Deutscher Wetterdienst, Hohenpeissenberg (Germany, F.R.). Meteorologisches Observatorium. 1990 166p. (In German). Order Number DE91756440. Source: OSTI; NTIS (US Sales Only).

The report of the second half of 1989 contains tables and diagrams with the data of ozone measurements carried out near to the ground as well as the general ozone and sulphure dioxide measurements made by the Hohenpeissenberg station. The tables on ozone rising also give the air pressure and temperature for any height of measurement. (orig.).

13427 (FMPC/Sub–29) **A Probabilistic Risk Assessment for the K-65 silos at the FMPC.** Janke, R. (Cincinnati Univ., OH (USA). Coll. of Engineering); Janke, R.; Ijaz, T. Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center; Cincinnati Univ., OH (USA). Coll. of Engineering. Nov 1990. 190p. Sponsored by USDOE,. DOE Contract AC05-86OR21600. Order Number DE91008415. Source: OSTI; NTIS; INIS; GPO Dep.

This study is intended to provide a general perspective of the overall risk assessment and to facilitate the understanding and relationship between the different phases of the study. The overall risk assessment embodied the potential for failure of the silos, the release and transport of contaminated material, the eventual exposure and dose, and finally the risk. The risk aspect of the study covers several different areas: (1) the probability of silo failure coupled the consequences of the failure (such as release), (2) the potential for wide spread contamination, and (3) the consequences of exposure and dose such as the possibility of latent cancer incidence. The accepted risk level from exposure to some quantity of radioactive material is not directly comparable to accepted risk levels for structural failure. In order to make a comparison the risks must be based on the same outcome. The results of this risk assessment clearly show that the total risks for the scenarios considered indicate the significance of the threat of release and exposure from the material in the K-65 silos. The chronic radon emission and the potential for the acute release of the radon contained in the head space are probably the more important since the likelihood of these events is either one or close to one. The acute release of residue material has a sufficiently small probability of occurrence that the risk can be considered to be the lesser of

the three scenarios. The risks posed by the other radionuclides (radon daughters) were found to result in sufficiently low doses that the scenarios could be eliminated. 20 refs., 37 figs., 62 tabs.

13428 (GKSS–90/E/24) **Numerical modelling of the atmospheric transport, chemical tranformations and deposition of mercury.** Petersen, G. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik); Schneider, B.; Eppel, D.; Grassl, H.; Iverfeldt, A.; Misra, P.K.; Bloxam, R.; Wong, S.; Schroeder, W.H. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). 1990. 18p. (CONF-900534–5: 18. NATO/CCMS international technical meeting on air pollution modelling and its applications, Vancouver (Canada), 13-17 May 1990). Order Number DE91754890. Source: OSTI; NTIS (US Sales Only).

Based on recent progress in the understanding of mercury chemistry and biogeochemistry and on the availability of mercury emission data bases this study makes an attempt to model the atmospheric transport of mercury, its chemical transformations in the atmosphere, and the fluxes of mercury to and from the earth's surface by means of an EMEP-type Lagrangian trajectory model for Europe and an Eulerian grid model (ADOM) for North America. Preliminary results with a simplified mercury chemistry scheme in the comprehensive Eulerian model and with a linear chemistry in the Lagrangian model show reasonable agreement with observed mercury concentrations in air and precipitation. (orig.) With 3 figs., 4 tabs.

13429 (GKSS–90/E/36) **Measurement of the absorption cross section of sulfur dioxide between 265 to 298 nm.** Thomsen, O. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich 12 - Physik. 1990. 99p. (In German). Order Number DE91759513. Source: OSTI; NTIS (US Sales Only).

Sulfur dioxide absorption cross sections are measured between 265 nm and 298 nm with <3 pm spectral resolution and ±4 pm maximum wavelength uncertainty. Cross-section standard deviation is ±1.5%. The apparatus used consits in a XeCl excimer laser pumping a Haensch-type oscillator-amplifier pulsed dye laser with echelle grating, KDP frequency doubler, 0.1-m absorption cell, and pyroelectric detector. Special emphasis was given the throughs in the absorption structure of sulfur dioxide which lend themselves to the lidar measurement of tropospheric ozone. (orig.) With 51 figs., 10 tabs.

13430 (KFK-PEF–73) **Heterogeneous reactions and aerosol formation in flue gas cleaning by electron beam.** Baumann, W. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1); Jordan, S.; Leichsenring, C.H.; Maetzing, H.; Paur, H.R.; Schikarski, W. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Aug 1990. 111p. (In German). Contract PEF 86/006/3. Order Number DE91754872. Source: OSTI; NTIS (US Sales Only); INIS.

The electron beam dry scrubbing process is a simultaneous method for the removal of SO_2 and NO_x from flue gas. By electron irradiation radicals (OH, O_2H, O) are formed from the main flue gas components which oxidize NO_x and SO_2 into the acids HNO_3 and H_2SO_4. These are then neutralized by the injection of NH_3. A submicron aerosol consisting of ammonium salts is formed which is filtered from the offgas. The main pathways of the gas phase chemistry and product formation have been elucidated by experimental and theoretical studies. Back reactions which occur in the gas and the particle phase limit the energy efficiency of the process. By recirculation of irradiated gas into the reaction vessel (multiple irradiation) a significant improvement of removal yields was obtained. This enhancement of the energy efficiency requires the removal of products between the irradiation steps. Studies show that the material balance is complete. Deficits in the N and S balance of the process are due to the additional formation of molecular nitrogen and the deposition of ammonium sulfate in the ducts. Aerosol formation participates only with 30% in the material balance. The remaining 70% of the product are formed by surface reactions in the filter cake (40%) and in the ducts (30%). (orig.) With 38 figs., 29 tabs.

13431 (KFK-PEF–74) **Anthropogenic impact on the ozone-forming potential of synthetic forest air.** Nolting, F. (Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)); Scheer, V.; Zetzsch, C. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Sep 1990. 54p. (In German). Contract PEF 89/001/2. Order Number DE91754803. Source: OSTI; NTIS (US Sales Only).

The influence of biogenic hydrocarbons on the ozone formation by the photochemical degradation of forest air was studied in this project. Simulation experiments were performed in a smog chamber with synthetic forest air that contained about 50 components according to recent field measurements in the Black Forest and near the Harz mountains. After addition of NO_x, this mixture was irradiated by a solar simulator, and the formation of ozone was studied at different hydrocarbon/NO_x ratios ranging from 0.5 to 25. Compared to hydrocarbonless experiments, the ozone maxima increase up to tenfold. To specify the influence of the terpenes, the experimental hydrocarbon levels were increased up to two orders of magnitude to 1000 ppbv compared to environmental levels of 13 ppbv. The ozone maximum is decreased just by a factor of two when the environmental terpene level is raised by two orders of magnitude. Simultaneously, the ozone maximum is reached more rapidly. First primary simulation model calculations confirm a limited contribution of the biogenic hydrocarbons to the overall ozone formation although the transformation of the terpenes contributes around 30% to the total of the hydrocarbons. (orig.) With 16 figs., 43 refs.

13432 (KFK-PEF–75) **Optimization of the separation of particles at high temperatures and simultaneous sorption of gases in a granular bed filter.** Peukert, W. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Mechanische Verfahrenstechnik und Mechanik). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Dec 1990. 190p. (In German). Contract PEF 88/001/3. Order Number DE91759563. Source: OSTI; NTIS (US Sales Only).

The application of granular bed filters opens the possibility of combining the particle filtration with the sorption of gaseous pollutants. One advantage of this filter is its relatively simple but robust design. The use of appropriate filter media enables the filtration at temperatures of up to 800deg C or even beyond that. In the scope of this research project favourable operational conditions for the simultaneous collection of particles and gaseous components have been derived. The influence of the temperature has been quantified in the range up to 800deg C. Concerning the particle collection, it could be demonstrated that the long term filtration behaviour and hence the effect of the filter loading is more favourable at elevated tempeatures. This has been verified with the aid of measured grade efficiency curves. The investigations into the sorption of HCl and SO_2 have been conducted under differential as well as integral conditions. In view of minimizing the wastes the attainment of high solid conversions has been one of the most impotant topics. The sorbents used incoporated in the most cases pellets agglomerated from fine limestone and $NaHCO_3$ dust powders using a rotary dics unit. In case of lime and limestone pellets the size of the parent dust particles proves to be a key parameter for the achievement of high solid conversions. Using pellets agglomerated from $NaHCO_3$ powder maximal sorbent exploitation is also possible at low temperatures of 200deg C. (orig.) With 87 figs., 127 refs.

13433 (LA–12000-ENV) **Environmental surveillance at Los Alamos during 1989.** Los Alamos National Lab., NM (USA). Dec 1990. 259p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009003. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the environmental surveillance program conducted by Los Alamos National Laboratory during 1989. Routine monitoring for radiation and radioactive or chemical materials is conducted on the Laboratory site as well as in the surrounding region. Monitoring results are used to determine compliance with appropriate standards and to permit early identification of potentially undesirable trends. Results and interpretation of data for 1989

cover external penetrating radiation; quantities of airborne emissions and effluents; concentrations of chemicals and radionuclides in ambient air, surface and ground waters, municipal water supply, soils and sediments, and foodstuffs; and environmental compliance. Comparisons with appropriate standards, regulations, and background levels provide the basis for concluding that environmental effects from Laboratory operations are small and do not pose a threat to the public, Laboratory employees, or the environment. 58 refs., 31 figs., 39 tabs.

13434 (NILU-OR-31/89) **NO_x emissions from gasoline and diesel oil combustion in mobile sources in Europe, 1985.** Larssen, S. Norsk Inst. for Luftforskning, Lillestroem (Norway). May 1989. 112p. Order Number DE91753008. Source: OSTI; NTIS (US Sales Only).

The report presents the method and results of calculation of NO_x from mobile sources (road traffic, rail traffic, internal navigation and agricultural tractors) for each country in Eastern and Western Europe in 1985. 65 refs., 14 tabs.

13435 (NILU-OR-53/89) **Ozone measurements in Norway 1987.** Hoem, K. (Statens forurensningstilsyn. Kontrollseksjonen i Nedre Telemark, Skien (NO)); Dreiem, R.; Schjoldager, J.; Stige, L.; Tveita, B. Norsk Inst. for Luftforskning, Lillestroem (Norway). Sep 1989. 118p. (In Norwegian). Order Number DE91753012. Source: OSTI; NTIS (US Sales Only).

Ozone measurements were carried out at ten sites during 1987. Hourly concentration exceeded 200 $\mu g/m^3$ only at one site, Prestebakke (204 $\mu g/m^3$). The concentration levels were generally considerably higher than the "critical levels" which were established in Europe in order to protect forests and other vegetation. 10 refs., 4 figs., 8 tabs.

13436 (NILU-OR-63/89) **Oxidant data collection in OECD-Europe 1985-87 (Oxidate).** Grennfelt, P. (Swedish Environmental Research Inst., Goeteburg (SE)); Saltbones, J.; Schjoldager, J.; Hoem, K. Norsk Inst. for Luftforskning, Lillestroem (Norway). Nov 1989. 211p. Order Number DE91753010. Source: OSTI; NTIS (US Sales Only).

The report summarizes hourly data from 36 regional measurement stations in 11 countries. Ozone data are given for 33 stations, nitrogen dioxide data for 12 stations and peroxyacetyl nitrate (PAN) data for three stations. Extreme values, monthly mean concentrations, frequency distributions, diurnal concentration variations and back trajectory sector distributions are given together with a brief discussion of oxidant episodes. 12 refs., 9 tabs., 12 figs.

13437 (NILU-OR-79/89) **Preliminary report from the Norwegian Institute for Air Research and the Norwegian Meteorological Institute on the greenhouse effect and the climate development.** Braathen, G.O.; Dovland, H.; Aune, B. Norsk Inst. for Luftforskning, Lillestroem (Norway); Norske Meteorologiske Inst., Oslo (Norway). Nov 1989. 67p. (In Norwegian). Order Number DE91753003. Source: OSTI; NTIS (US Sales Only).

Anthropogenic emissions of greenhouse gases will probably result in an effective doubling of the present CO_2 concentration within year 2030. According to climate model calculations this will lead to an increase in the global mean temperature of 2 - 3°C. In Norway one can expect an increase of 3 - 4°C in the winter temperature, and summers will be 2°C warmer than today. Climate models at their present stage of development, are ridden with large uncertainties and much work remains to be done before the models can give reliable projections for the future climate on regional and local scales. 43 refs., 21 figs., 8 tabs.

13438 (NORD-90-22) **The presence, accumulation and potential impact of organic compounds on forest ecosystems in Scandinavia.** Skaerby, L. (Swedish Environmental Research Institute, Stockholm (SE)); Gould, R. Nordisk Ministerraad. 1990. 54p. Order Number DE91753038. Source: OSTI; NTIS (US Sales Only).

This review has considered six classes of organic pollutants, their presence in the environment, their accumulation in leaf tissues, and their known effects on plants with particular reference to forest trees. The classes of organic compounds that have been reviewed are: polynuclear organic matter (POM), organochlorine pesticides and polychlorinated biphenyls (PCB), halogenated hydrocarbons, volatile organic compounds (VOCs), phthalate esters and peroxyacetyl nitrate. Considering forest trees, very few studies have looked at the direct effects of any of these classes of compounds and very few more have considered plants at all. In some cases, these pollutants have not even been monitored in some parts of the world, including Scandinavia. In the past few years, there has been a growing body of evidence that soil acidification and trophosheric ozone cause negative effects on many plants and forest species in the USA, Europe and Scandinavia. Lately, measurements in Germany indicate that some halocarbons and many other organic compunds may have a negative impact on conifers. It is possible that halocarbons may contribute to forest decline in Scandinavia, but until there is an extensive program of monitoring combined with epidemiological studies, it is impossible to say one way or another. It is difficult also to make direct comparisons between the symptoms of forest decline in different parts of Europe; not only are the soils and ecosystems different, but so too are the pollution climates. Whatever the cause of forest decline, it is certainly due to more than one stress factor, and there is evidence to implicate air pollutants in this picture. (109 refs.).

13439 (NUREG/CR-5536) **DCM3D: A dual-continuum, three-dimensional, ground-water flow code for unsaturated, fractured, porous media.** Updegraff, C.D. (GRAM, Inc., Albuquerque, NM (USA)); Lee, C.E.; Gallegos, D.P. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA); GRAM, Inc., Albuquerque, NM (USA); Applied Physics, Inc., Albuquerque, NM (USA). Feb 1991. 139p. Sponsored by Nuc. DOE Contract AC04-76DP00789. (SAND-90-7015). Source: OSTI; NTIS; INIS; GPO.

This report constitutes the user's manual for DCM3D. DCM3D is a computer code for solving three-dimensional, ground-water flow problems in variably saturated, fractured porous media. The code is based on a dual-continuum model with porous media comprising one continuum and fractures comprising the other. The continua are connected by a transfer term that depends on the unsaturated permeability of the porous medium. An integrated finite-difference scheme is used to discretize the governing equations in space. The time-dependent term is allowed to remain continuous. The resulting set of ordinary differential equations (ODE's) is solved with a general ODE solver, LSODES. The code is capable of handling transient, spatially dependent source terms and boundary conditions. The boundary conditions can either prescribed head or prescribed flux. 24 refs., 22 figs., 5 tabs.

13440 (ORNL/FTR-3867) **[Seminar on anthropogenic emissions of greenhouse gases]: Foreign trip report, February 15-February 22, 1991.** Marland, G.H. Oak Ridge National Lab., TN (USA). 28 Feb 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009110. Source: OSTI; NTIS; GPO Dep.

The traveler participated in an Organization for Economic Cooperation and Development (OECD) expert seminar on anthropogenic emissions of greenhouse gases. The meeting was initiated by OECD in anticipation of the need for national estimating emissions of greenhouse gases which will precede an international convention on greenhouse gases. The meeting which attracted delegates from 44 countries, began the process of developing a standardized methodology and a set of guidelines so that individual countries can calculate their own emissions of greenhouse gases in a way that is transparent and comparable among nations. The meeting considered all anthropogenic sources of CO_2, CH_4, N_2O, and some other chemically active gases but specifically left chlorofluorocarbons (CFCs) for other international processes. The traveler had an opportunity to review the background document for the meeting and was invited to open the working session on CO_2 emissions from combustion sources by summarizing and critiquing the background document. The meeting concluded with a commitment to complete a guidelines document to be published by OECD. There was tentative accord that some developing nations would require technical assistance to complete such an inventory while some developed nations would be willing to provide that assistance.

13441 (ORNL/M-1155) **Environmental surveillance data report for the second quarter of 1990.** Goldberg, P.Y.; Horwedel,

B.M.; Osborne-Lee, A.E.; Powell, M.R.; Stevens, M.M.; Tardiff, M.F.; Valentine, C.K.; Wolf, D.A. Oak Ridge National Lab., TN (USA). Feb 1991. 102p. Sponsored by USDOE, Washington, DC (USA). DOE · Contract AC05-84OR21400. Order Number DE91009194. Source: OSTI; NTIS; GPO Dep.

Each section of this report consists of a program description; results for the quarter; and an analysis of trends over the previous two years, depending upon the availability of data. Emissions of tritium to the atmosphere returned to levels consistent with the latter part of 1989. Osmium-191 releases were down by a factor of fifty due to changes in operations. Ambient air sampling around ORNL and the reservation showed that I-131 and H-3 continue to be at concentrations of less than 0.01% of the derived concentration guides (DCG) for these isotopes. Tritium and strontium concentrations at White Oak Dam were at 11% and 22% of their DCGs for the quarter respectively. All of the other radionuclides that were evaluated at the dam were at 2% or less of their DCGs. The NPDES compliance ratio for this quarter was 97% due to 20 noncompliances. Twelve of the exceedences were due to Category outfalls. Total radioactive strontium in milk was detected at two of the stations. The concentrations were less than 1% of the DCG for Sr-90. Samples from the perimeter wells of SWSA 6 were consistent with the data collected during the assessment phase with the exception of one well that showed twice the concentration of tritium previously seen (920 Bq/L versus 530 Bq/L). 20 figs., 39 tabs.

13442 (SB-UB-90-39) **Calculations of the carbon balance when utilizing Swedish forests for biofuel.** Aagren, G. (Sveriges Lantbruksuniv., Uppsala (SE). Inst f Ekologi och miljoevaard). Statens Vattenfallsverk, Vaellingby (Sweden). 14 Mar 1990. 18p. (In Swedish). Order Number DE91753033. Source: OSTI; NTIS (US Sales Only).

A mathematical model describing carbon and nitrogen turnover in a spruce forest has been used to calculate the carbon accumulation for two different site classes, G24 and G32 (indicating different levels of productivity - the higher figure being the higher level), with different management intensities. The calculations show that the long-term accumulation of carbon in a G32 forest is approximately twice as large as that in a G24 forest with corresponding silvicultural intensity. With a silvicultural intensity directed at maximum carbon accumulation, this will increase by about 50% in comparison with the management recommended for conventional forestry (from 0.9 to 1.35 Mg C $ha^{-1}yr^{-1}$ in a G24 forest and from 2 to 3 Mg C $ha^{-1}yr^{-1}$ in a G32 forest). In a G32 forest, where broad-leaf trees are allowed to grow freely during the first 15 years after a clearcut, the effects of silvicultural inputs on carbon accumulation will be considerably less. An increased utilization of biomass through the removal of branches in connection with felling has a negligible effect on the long-term carbon accumulation. Finally, it is demonstrated that a spruce forest without removal of carbon contains, on average, 3-4 times as much carbon as corresponding arable land.

13443 (SVF-373) **The energy system and the greenhouse effect - especially the consequences of emissions of carbon dioxide from different types of fuels.** Rosen, P. (Lund Univ. (Sweden). Dept. of Heat and Power Engineering); Torisson, T. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Aug 1990. 53p. (In Swedish). Order Number DE91753079. Source: OSTI; NTIS (US Sales Only).

This report deals with the so called greenhouse effect, especially the contribution from carbon dioxide. It is written for people with special interest in the energy sector and is based on literature studies. One of its prime objects is to try to sort out the facts from the assumptions concerning the greenhouse hypothesis. It treats the carbon cycle, other greenhouse gases, fossil fuels versus biofuel, emissions of carbon dioxide from different types of fossil fuels and power stations, strategies to minimize the emissions of carbon dioxide, risks linked with a greenhouse warming, international agreements and national government policies and some explanations of fundamental expressions used in climatological literature. The authors' opinion is that it is still too early to draw any conclusions, based on scientifically established facts, as to whether the antropogenic contribution of greenhouse gases to the atmosphere have a major influence on the climate of the earth. The uncertainties in the hypothesis are still great in some important areas, for instance the air-sea exchange of carbon dioxide, cloudiness, historical data and the poorly understood historical changes of the climate. (authors).

13444 (SVF-384) **Water injection for NO_x-reduction in natural gas combustion.** Fermbaeck, G. (Theorell + VBB Energikonsulter AB, Stockholm (SE)); Jantze, U.; Jedeur-Palmgren, M.; Wanselius, K. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1990. 60p. (In Swedish). Order Number DE91753063. Source: OSTI; NTIS (US Sales Only).

A theoretical model for the thermal dependency for NO-formation is shown. With cooling of the flame by water injection, calculations show a significant NO-reduction. A literature survey covering reports from tests made with water injection has been performed. All found reports support the theory that water injection is a useful NO-reducing method. Three different test on gasfired boilers showed a 70% reduction of NO-formation when 5% wt water, calculated on the total flue gas flow, was injected. These studies also found that the NO-reduction increased with the amount of water up to 20-25% wt, where instability of the flame occurred. Two of these test investigated the amount of unburnt but no results from these measurements has been presented. A reference is also made to a test with water injection in an oil flame. In this test the authors have found a relation between the amount of NO-reduction and the position of the water injection nossle. This means that it should be possible to optimize the NO-reduction in gas flames not only by the amount of water but also by the geometrical outfit of the burner and water injection nossle. An experimental test is proposed in order to evaluate the risk on incomplete combustion as a result of water injection. (authors).

13445 (SV-V-90-35) **Continuous stack gas measurements and analysis of emissions from Hallsberg CO-generation plant.** Brunstroem, C. Swedish State Power Board, Vaellingby (Sweden). 5 Jan 1990. 24p. (In Swedish). Order Number DE91753024. Source: OSTI; NTIS (US Sales Only).

Equipment for continuous stack gas control has been installed at cogeneration plant in Hallsberg. A dilution system was used for analysis of sulphur and nitrogen oxides. A separate automated data handling system was installed by Vattenfall Utveckling AB, Aelvkarleby Laboratory. In this report installed instruments and systems are described. Different principles for calculation and analysis of emissions are then described and compared. Finally experiences from the operation of the measurement system are reported. Analysis of emissions from combustion processes require knowledge of the flow in the stack. The flow can be directly measured or indirectly determined through calculations based on data from a fuel analysis. The installed equipment in Hallsberg makes it possible to evaluate the two methods in parallel. Results show that good agreement can be obtained if the flow instrument is correctly installed and maintained. The indirect method is, however, recommended for permanent installations until more experience from different types of gas flow instruments installed in stacks are gained. The accuracy in measured hourly mean concentrations and corresponding emissions was for the installed system calculated to about $\pm$ 20%. Possibilities to improve the accuracy to $\pm$ 10% are discussed in the report. Due to statistical reasons the accuracy in the hourly results are, however, of minor interest for the long-term mean values. High quality long-term results are obtained if systematical errors are avoided through regular control and calibration of the measurement system. (author).

13446 (UCRL-LR-105199) **Environmental Technology Program: Annual report FY90.** Lawrence Livermore National Lab., CA (USA). 2 Jan 1991. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009070. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory's Environmental Technology Program was organized in FY90 to research, develop, demonstrate, test, and evaluate innovative technologies for reducing the costs and increasing the effectiveness of environmental restoration and waste management. The Environmental Technology Program is organized into the following main elements, each of which represents an integration of individual tasks and activities to meet program objectives: (a) Hazard Assessment and Risk Management, (b) Characterization, Monitoring, and Analysis, (c)

Subsurface (Groundwater and Soil); Remediation: Waste Treatment; Waste Minimization, and Education Initiatives. Individual papers are processed separately for appropriate data bases.

13447 (UCRL-MA-105607) **User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases.** Ermak, D.L. Lawrence Livermore National Lab., CA (USA). Jun 1990. 137p. Sponsored by American Petrole. DOE Contract W-7405-ENG-48. Order Number DE91008443. Source: OSTI; NTIS; GPO Dep.

SLAB is a computer model that simulates the atmospheric dispersion of denser-than-air releases. The types of releases treated by the model include a ground-level evaporating pool, an elevated horizontal jet, a stack or elevated vertical jet, and an instantaneous volume source. Except for the evaporating pool source which is assumed to be all vapor, all of the remaining sources may be either pure vapor or a mixture of vapor and liquid droplets. Atmospheric dispersion of the release is calculated by solving the conversation equation of mass, momentum, energy, and species. The conservation equations are spatially averaged so as to treat the cloud as either a steady state plume, a transient puff, or a combination of the two depending upon the duration of the release. The mathematical description of the physics of heavy gas dispersion (gravity spread, reduced turbulent mixing, etc.) as well as the description of the normal atmospheric advection and turbulent diffusion processes, are inherently included in the conservation equations. The time-averaged concentration predicted by SLAB depends on not only the various physical phenomena associated with the dispersion equations, but also on the specified concentration averaging time. Typical dispersion simulations require only a few minutes on an IBM-AT class personal computer. This report presents a theoretical description of the model, guidance for running the model and interpreting the results, and four example problems to illustrate the use of the model. 31 refs., 11 figs., 6 tabs.

13448 (WHC-EP-0165-2) **Westinghouse Hanford Company 100 Areas environmental releases for 1989.** Rokkan, D.J. Westinghouse Hanford Co., Richland, WA (USA). Nov 1990. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009160. Source: OSTI; NTIS; GPO Dep.

This document contains information on nonradioactive and radioactive substances released to the environment from Westinghouse Hanford Company (Westinghouse Hanford) facilities in the 100 Areas during calendar year 1989. Analyses of samples routinely collected from radioactive liquid and airborne streams were performed by a contract laboratory and the Westinghouse Hanford 100-N radioanalytical laboratory. Analyses of nonradioactive constituents were performed by the Hanford Environmental Health Foundation and the Westinghouse Hanford 100-N water chemistry laboratory. The N Reactor has been shutdown since January 7, 1987. Because of this continued shutdown, both the radiological and chemical releases in 1989 were generally less than in previous years. The extended shutdown was initially ordered to allow upgrading of reactor safety systems. Following completion of most upgrades, N Reactor has remained shutdown, in "cold standby." The reactor has been kept in cold standby due to recent decisions affecting its role in the production of special nuclear materials. No adverse trends were observed in the routine discharges of radioactive and chemical constitutents. Releases from 100-N Area were within the Westinghouse Hanford technical specifications that limit operation of the N Reactor. 10 refs., 21 tabs.

13449 (WHC-EP-0258-1) **Westinghouse Hanford Company environmental surveillance annual report: 100 Areas: Calendar year 1989.** Perkins, C.J. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 114p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009158. Source: OSTI; NTIS; GPO Dep.

Near-field environmental surveillance of the Hanford Site 100 Area is performed by Westinghouse Hanford Company (Westinghouse Hanford) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers. Results from the Westinghouse Hanford Environmental Surveillance Program for the Hanford Site 100 Areas are presented in this report. The environmental surveillance program provides sampling and monitoring of several parameters to evaluate the environmental impact of 100-N Area Reactor Facilities and the shutdown reactor facilities and burial grounds in the retired 100 AREAS. Discharges to the environment are reported in annual effluent release reports. At the 100-N Area, samples of ambient air, groundwater, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the environmental impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDF). Direct radiation surveys were conducted for each LWDF and along the Columbia River shoreline. At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from groundwater monitoring wells located at the 100-K Area were collected and analyzed. The results are provided in this report. 18 refs., 21 figs., 21 tabs.

13450 (WSRC-RP-90-1209) **Dispersion calculations for non-radiological hazardous chemical emissions from the Defense Waste Processing Facility and related activities.** Hunter, C.H. Westinghouse Savannah River Co., Aiken, SC (USA). 22 Oct 1990. 24p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. Order Number DE91009305. Source: OSTI; NTIS; GPO Dep.

The Environmental Protection Agency's (EPA) Industrial Source Complex – Short Term (ISCST) air dispersion model was used to examine potential atmospheric impacts of routine benzene and mercury emissions from the Defense Waste Processing Facility (DWPF), In-Tank Precipitation (ITP) facilities, and the Saltstone Facility. The highest model estimated 8-hour average ground-level benzene concentrations were found to occur in the immediate vicinity of the ITP filter/stripper building (241-96H). Subsequent model calculations were used to determine minimum stack release heights that would be necessary to achieve compliance with this workplace exposure standard for currently anticipated emission levels. The highest 24-hour average site boundary concentrations of benzene and mercury generally occurred to the north of S and H areas. Concentrations were well below the ambient concentration standards that have been identified for these substances in an air toxics policy proposed by the State of South Carolina. Estimates of annual average benzene concentrations for offsite locations were used to estimate the excess lifetime cancer risk. Assuming continuous 70-year exposure to the estimated annual benzene concentrations, the excess cancer risk to the maximum exposed individual was estimated to be 3×10^{-7}. Similar lifetime exposure summed over the surrounding population resulted in an estimated average of 6×10^{-4} excess cancers per year. 14 refs., 1 fig., 7 tabs.

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Refer also to citation(s) 12355, 12356, 12434, 12435, 12436, 12437, 12438, 12439, 12453, 12479, 12481, 12512, 12514, 12516, 12517, 12518, 12522, 12534, 12536, 12557, 12563, 12564, 12588, 12847, 12849, 12947, 13151, 13204, 13205, 13206, 13338, 13343, 13419, 13423, 13433, 13439, 13441, 13446, 13448, 13449, 13501, 13502, 13504, 13507, 13517, 13521, 13560, 13569, 13573, 13577, 13752, 13932

13451 (BfS-ISH-146/90) **Cesium and potassium uptake by plants from soils.** Schaller, G.; Leising, C.; Krestel, R.; Wirth, E. Bundesamt fuer Strahlenschutz, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Nov 1990. 90p. (In German). Order Number DE91754871. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the investigation was the reliable estimation of the Cs-137 root uptake by agricultural crops using the 'observed ratio model' (OR model) for the determination of transfer factors: Cs (plant)/K (plant) = OR x Cs (soil)/K (soil). For model validation representative soil (arable land, grass land, organic substrates from forests and peat) and plant samples from Bavaria were taken. These 4 parameters varied within a sufficiently wide range. In addition some samples from forest sites were taken. Soil and plant samples were taken at the same locations within 1 m^2. (orig./HP).

13452 (CEAC-R-6-90) **Determination of moisture in bagasse by neutron reflection.** Diaz Rizo, O. (Instituto Superior de Ciencia y Tecnologia Nuclear (ISCTN), La Habana (Cuba)); Suarez, J.C. Comision de Energia Atomica, La Habana (Cuba). 1990. 8p. (In Spanish). Order Number DE91623282. Source: OSTI; NTIS (US Sales Only); INIS.

For the first time in Cuba organic samples were analyzed by neutron reflection method. The feasibility of this method to determinate the moisture grade in sugar cane bagasse is fixed. From 0 to 50w% moisture grade with 2-3% relative accuracy can be determinated using 10m. measuring time. 7 refs.

13453 (CONF-8909163–Vol.2, pp. 141-159) **Hydrologic testing in exploratory drill hole UE4T, Yucca Flat, the Nevada Test Site.** Hawkins, W.L. (Los Alamos National Lab., NM (USA)); Trudeau, D.A.; Miheve, T.M. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Ue4t is a 0.25-m diameter hole drilled in early 1987 to a total depth of 736 m in the central portion of Yucca Flat. The water level in this uncased hole rose to a depth of 268 m below land surface datum (LSD); however, the estimated depth to the water table is 506 m. Elevated fluid levels are responsible for emplacement hole construction problems and may affect radionuclide migration. Straddle packer testing was conducted in Ue4t during January, February and May of 1989 to determine the vertical hydraulic gradient, the magnitude of formation fluid pressures and to define the water table. Results from the hydrologic testing indicate that there is a general upward hydraulic gradient in hole Ue4t because the lowest formation pressure (287 psia) was measured between the surface and a depth of 542 m below LSD, while the highest formation pressure (755 psia) was measured between 629 m and the bottom of the hole. The general upward pressure gradient is not evident between 542 m and 629 m below LSD as the formation pressures in this interval are between 501 psia and 571 psia. Testing to determine the location of the water table in Ue4t was unsuccessful due to communication around the packers. Pressure buildup below the bottom packer set at 525 m caused hydrofracture around the packers. Similar hydrofracture occurred during the straddle packer testing of the interval between the 597 m and 607 m.

13454 (CONF-9009350–1) **Unsaturated transport of inorganic cations in undisturbed soil columns.** Jardine, P.M.; Jacobs, G.K. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Radionuclide adsorption workshop; Los Alamos, NM (USA); 11-12 Sep 1990. Order Number DE91008873. Source: OSTI; NTIS; INIS; GPO Dep.

The unsaturated transport of Sr, Co, and Ca were studied in undisturbed soil columns (14 x 40 cm) of saprolitic shale to evaluate the significance of time dependent mass transfer and multispecies competitive exchange during transport. Observed breakthrough curves (BTCs) for Sr and Co were delayed relative to nonreactive Br BTC indicating that the former tracers were adsorbed by the soil. Effluent concentrations of Sr and Co were modeled with the classical convective dispersive (CD) equation and nonequilibrium mass transfer considerations did not appear necessary. Cation exchange equilibria relationships obtained from both shake batch and miscible displacement methods adequately described the thermodynamic processes which were prevalent during transport. These results suggest that the preferential transport of a reactive tracer is negligible for the realistic unsaturated conditions used in the study, and that the massive saprolite within the soil is a chemically active constituent during transport of reactive solutes. The implications of these findings for modeling in-situ subsurface contaminant transport are discussed. 7 refs., 9 figs.

13455 (CONF-9103136–1) **Interactions between water stress and elevated CO_2 in five eastern deciduous tree seedlings.** Stewart, D.B. (Pennsylvania State Univ., University Park, PA (USA). Dept. of Biology). Oak Ridge National Lab., TN (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA). DOE Contract AC05-84OR21400. From 5. national conference on undergraduate research; Pasadena, CA (USA); 21-23 Mar 1991. Order Number DE91009132. Source: OSTI; NTIS; GPO Dep.

Many studies have shown effects of increased levels of atmospheric CO_2 on the water relations of plants, including an increase in both instantaneous and whole plant water-use efficiency (WUE), primarily as a result of lowered stomatal conductance, enhanced photosynthesis, or both factors in combination; however, few studies have been done on trees (Morison 1985; Eamus and Jarvis 1989). While increased WUE has been demonstrated in potted tree seedlings grown in elevated CO_2, it is not known whether an increased WUE will impart increased resistance to drought. In our study, interactions between drought stress and elevated CO_2, varied by species. The results indicate the possibility for changes in competition between trees species with increased levels of atmospheric CO_2 and that competition will be different between moist and dry sites. For instance, growth of both sycamore and sugar maple was increased under elevated CO_2 when these plants were well-watered, but water stress precluded the CO_2 enhancement. However, elevated CO_2 ameriorated some of the effects of drought in red oak, and drought did not inhibit the response of yellow-poplar to the elevated CO_2 treatment. While short-term studies such as this can indicate the possibility of changes in forest succession resulting from increases in atmospheric CO_2 levels and drought frequency, longer-term studies with mature trees are important for enhancing the resolution of insight into the dynamics of forest ecosystems. 10 refs., 2 figs., 1 tab.

13456 (DOE/ER/60581–3) **Effects of vegetation on radon transport processes in soil: Progress report.** Borak, T.B. Colorado State Univ., Fort Collins, CO (USA). [1991]. 26p. Sponsored by USDOE,. DOE Contract FG02-87ER60581. Order Number DE91008515. Source: OSTI; NTIS; GPO Dep.

This research was conducted to measure radon concentrations. Radon concentrations in soil gas were measured on a weekly schedule. Samples were extracted through the tubes used for measuring pressure differentials at depths of 30, 100, 180 cm. The average soil moisture content was measured with the neutron gauge. Other soil parameters such as soil temperature and meteorological data were analyzed in order to determine their influence on soil radon concentrations. For indoor radon concentrations, 15 minute measurements were used to obtain a monthly average for one structure from January 1989–August 1990. Also measured were wind speed and pressure differential correlations with radon concentration. The salient features of the data obtained thus far are as follows: radon gas concentrations in the silty clay surrounding the structures increased with depth; monthly averaged radon concentrations in the underground structures do not exhibit obvious seasonal variations; indoor radon concentrations are not correlation with pressure differences between the structure and surrounding soil; for these structures the radon entry rate has two components; one that is constant and the other that changes with time; and the wind speeds that increase the radon entry rate, also increase the ventilation rate. 11 figs.

13457 (DOE/ER/60664–6) **A unifying theory of radon generation and transport in porous media: Final report.** Nielson, K.K.; Rogers, V.C. Rogers and Associates Engineering Corp., Salt Lake City, UT (USA). Feb 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER60664. Order Number DE91009044. Source: OSTI; NTIS; GPO Dep.

This report documents the activities by Rogers and Associates Engineering Corporation during the extension period of the second year of grant DE-FG02-88ER60664. The overall research objectives have been to develop a general, unified theory of radon emanation and transport and to implement it in a computer code for application in routine and specialized field studies and research programs. A theoretical correlation of soil textural properties with radon transport characteristics was predicted by analyses with the unified theory model. This correlation was dominated by soil water contents, but exhibited also some particle-size dependence. Feasibility measurements were completed for partitioning moisture effects on radon emanation into two categories: pore water contents and hydrated (crystalline) water contents. Preliminary radon

emanation measurements that control these water categories provide new insight into radon emanation mechanisms and parent radium distributions in the selected mineral samples. The 2-dimensional RAETRAD model for indoor radon entry was further refined to include the complete multiphase aspects of the unified theory as incorporated in the RAETRAN model. The RAETRAD model was applied to various generic and site-specific problems, and was specifically compared with indoor and soil-gas radon measurements for 12 houses in Florida. During these analyses, and as part of other sensitivity analyses with the RAETRAD model, the importance of diffusive radon entry through the concrete floor was observed. Further analyses and measurements of the diffusion and permeability coefficients of residential floor concretes were conducted.

13458 (EGG–10617-1062) **An aerial radiological survey of the Hanford Site and surrounding area, Richland, Washington: Date of survey, July–August 1988.** EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Remote Sensing Lab. Oct 1990. 50p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-88NV10617. Order Number DE91008633. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted over the Department of Energy's Hanford Site near Richland, Washington, during the period 5 July through 26 August 1988. The survey was expanded, and additional flights were conducted to the east of the site and along the banks of the Columbia River down to McNary Dam near Umatilla. The survey was flown at altitude of 61 meters (200 feet) by a helicopter containing 17 liters (eight 2 in. x 4 in. x 16 in.) of sodium iodide detectors. Gamma ray data were collected over the survey area by flying north-south lines spaced 122 meters (400 feet) apart. The processed data indicated that detected radioisotopes and their associated gamma ray exposure rates were generally consistent with those expected from normal background emitters and man-made fission/activation products resulting from activities at the site. External exposure rates were generally 10 microroentgens per hour (μR/h) with some operating areas over 1000 μR/h. The radiation levels over more than 95% of the site are due to normal background exposure rates. 3 refs., 25 figs.

13459 (ENEA-RT-AMB–90-05) **Environmental model uncertainty evaluation: Experience in radiation protection field.** Monte, L. ENEA, Casaccia (Italy). Area Energia, Ambiente e Salute. Oct 1990. 17p. (In Italian). Order Number DE91752930. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper, an evaluation of the output uncertainty of an environmental model for assessing the transfer of cesium 137 and iodine 131 in the human food chain is carried out on the basis of a statistical analysis of data reported in literature. The uncertainty analysis offers the opportunity of obtaining some remarkable information about the uncertainty of models predicting the migration of non-radioactive substances in the environment, mainly in relation to dry an wet deposition.

13460 (IAEA-TECDOC–579, pp. 59) **Migration of some radionuclides through the surroundings of a shallow land burial facility.** Baranyai, L. (Magyar Tudomanyos Akademia, Budapest (Hungary). Izotopintezete); Pentz, G. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Abstract only.

Laboratory migration tests were carried out to study the migration behaviour of the most hazardous radionuclides ^{137}Cs, ^{60}Co, ^{90}Sr and ^{125}I in the substance of the engineered barrier and in the surrounding of a planned repository. Experimental results were applied for fitting a migration model to the data and for determining the actual dispersion coefficients for the given barriers and radioisotopes. The long term dispersion of the radioisotopes was predicted by means of these actual dispersion coefficients for about 300 years and safety aspects of the planned repository were estimated.

13461 (IAEA-TECDOC–579, pp. 47-48) **Soil chemical exchange and migration of radionuclides (SCEMR) and plant transfer factors in northern environments.** Sheppard, M.I. (Atomic Energy of Canada Ltd, Pinawa, Manitoba (Canada). Environmental Research Branch); Sheppard, S.C. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. 2 refs. GROUND WATER/radionuclide migration; RADIONUCLIDE MIGRATION/capillary flow; RADIONUCLIDE MIGRATION/leaching; SOILS/radionuclide migration; CESIUM; FIELD TESTS; IODINE; ISOTOPE RATIO; MOLYBDENUM; NEPTUNIUM; RADIOACTIVE WASTE DISPOSAL; LEACHING; SOILS; TECHNETIUM; THORIUM; URANIUM

13462 (IAEA-TECDOC–579, pp. 49-50) **Safety assessment of a disposal facility for low and medium level waste: Results of a sensitivity analysis.** Guetat, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique); Foult, T. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GROUND WATER/radionuclide migration; RADIOACTIVE WASTE DISPOSAL/safety; GROUND DISPOSAL; INTERMEDIATE-LEVEL RADIOACTIVE WASTES; LOW-LEVEL RADIOACTIVE WASTES; SAFETY

13463 (IAEA-TECDOC–579, pp. 51-53) **Migration and interaction of radioactive waste radionuclides in major soils of Iraq.** Fahad, A.A. (Iraq Atomic Energy Commission, Baghdad (Iraq). Nuclear Research Centre). International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. RADIOACTIVE WASTES/ground disposal; SOILS/radionuclide migration; CESIUM 137; COBALT 60; LEACHING; SOILS; WATER

13464 (IAEA-TECDOC–579, pp. 54-55) **Shallow burial projects - Delft Geotechnics: Soil heterogeneities and transport of radionuclides.** Loxham, M. (Delft Geotechnics, Delft (Netherlands)); Meurs, G.A.M. van; Weststrate, F.A.; Visser, W. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GROUND DISPOSAL/low-level radioactive wastes; GROUND DISPOSAL/radionuclide migration; RADIONUCLIDE MIGRATION/multi-parameter analysis; ENVIRONMENTAL EXPOSURE PATHWAY; FIELD TESTS; GROUND WATER; SOILS

13465 (IAEA-TECDOC–579, pp. 56-58) **Migration and biological transfer of radionuclides from shallow land burial.** Siraky, G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. LOW-LEVEL RADIOACTIVE WASTES/ground disposal; RADIONUCLIDE MIGRATION/risk assessment; ENVIRONMENTAL EXPOSURE PATHWAY; FIELD TESTS; GEOLOGIC SURVEYS; SOILS

13466 (IAEA-TECDOC–579, pp. 63-65) **Migration and biological transfer of radionuclides from shallow land burial.** Dlouhy, Z. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Horyna, J. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated*

research programme 1985-1989. 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GROUND WATER/radionuclide migration; RADIOACTIVE WASTE DISPOSAL/radionuclide migration; ENVIRONMENTAL EXPOSURE PATHWAY; EVALUATION; GROUND DISPOSAL; HYDROLOGY; RADIATION DOSES

13467 (IAEA-TECDOC–579, pp. 66-67) **Migration and biological transfer of radionuclides from shallow land burial.** Narayan, P.K. (Bhabha Atomic Research Centre, Bombay (India). Waste Management Div.); Ozarde, P.D. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. RADIOACTIVE WASTE DISPOSAL/radionuclide migration; SOILS/ground disposal; SOILS/radionuclide migration; BIOINTRUSION; CESIUM 134; COMPARATIVE EVALUATIONS; COMPUTERIZED SIMULATION; D CODES; FIELD TESTS; SOILS; STRONTIUM 85

13468 (IAEA-TECDOC–579, pp. 68-70) **Summary of the work on radionuclide migration at JAERI.** Kato, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Wadachi, Y. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. RADIOACTIVE WASTE DISPOSAL/ground disposal; RADIOACTIVE WASTE DISPOSAL/radionuclide migration; RADIONUCLIDE MIGRATION/soils; FIELD TESTS; ISOTOPE RATIO; LOW-LEVEL RADIOACTIVE WASTES; SOILS; RISK ASSESSMENT

13469 (IAEA-TECDOC–579, pp. 71-72) **Migration and biological transfer from shallow land burial facilities.** Klos, R.A. (National Radiological Protection Board, Chilton (UK)); Mobbs, S.F. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. 2 refs. RADIOACTIVE WASTE DISPOSAL/risk assessment; RADIONUCLIDE MIGRATION/computer codes; RADIONUCLIDE MIGRATION/ground disposal; BIOINTRUSION; LOW-LEVEL RADIOACTIVE WASTES; RADIOACTIVE WASTE FACILITIES

13470 (IAEA-TECDOC–579, pp. 27-44) **Biological transport from shallow land burial.** Caldwell, L. (Battelle Pacific Northwest Lab., Richland, WA (USA)); Leising, C.; Roemmelt, R.; Wirth, E. International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper a general overview is given of the limiting conditions for the survival of plants and soil animals. On the basis of this information the question of whether intrusion by plants and animals may be an essential exposure pathway in shallow land disposals is considered. (author). 40 refs, 3 figs.

13471 (IAEA-TECDOC–579, pp. 60-62) **Summary of the investigations of phenomena affecting radiological model predictions from radionuclides in surface layer of the earth.** Wirth, E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). International Atomic Energy Agency, Vienna (Austria). Dec 1990. In *Migration and biological transfer of radionuclides from shallow land burial: Final report of a co-ordinated research programme 1985-1989.* 72p. Order Number DE91622513. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. BIOINTRUSION/animals; BIOINTRUSION/roots; RADIONUCLIDE MIGRATION/biointrusion; BIOINTRUSION; ANIMALS; ROOTS; GROUND DISPOSAL; ISOTOPE RATIO; LOW-LEVEL RADIOACTIVE WASTES; RADIATION DOSE DISTRIBUTIONS

13472 (IKU-R–34.2847.00/01/90) **Disposal of CO_2 in the oceans and in non-oilbearing geologic formations.** Holt, T.; Lindeberg, E.G.B. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Mar 1990. 15p. (In Norwegian). Order Number DE91753014. Source: OSTI; NTIS (US Sales Only).

Four different alternatives for the disposal of CO_2 from concentrated emissions, e.g. power plants, are presented. All the methods are based on the principle that CO_2 is separated from the waste gas by means of a chemically active adsorption/desorption process. The concentrated CO_2 gas is compressed and conveyed to the place in question. Simple estimates for disposal of CO_2 at a sea depth of 500 m show that the investment costs for a 1000 MW gas power plant, increase with more than 100% compared to direct emission. This will increase the price of the electric power with about 0.12 NOK/kWh (Norwegian Kroner/kWh). Disposal at a sea depth of 3000 m is not considered to be a realistic alternative today, because of difficulties in laying pipelines at that depth. In the same way, disposal of CO_2 in non-oilbearing geologic formations and salt caverns, will increase the investment costs of a 1000 MW gas power plant with 85% and 80% respectively. This will imply an increase of the power price with 0.12 NOK/kWh and 0.20 NOK/kWh respectively. 11 refs., 4 tabs.

13473 (INIS-mf–12779, pp. 57-63) **Comments on the methods used to interpret the radionuclide mobility in the Koongarra uranium ore deposit.** Golian, C. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Jan 1990. 146p. In *Alligator Rivers analogue project: First annual report 1988-1989.* Order Number DE91618691. Source: OSTI; NTIS (US Sales Only); INIS.

Data for saleeite crystals have been used to gain information on local formation times and hence on the uranium mobility in the weathered zone. The work is based upon a model which considers crystallization being completed in a relatively short time with no significant deposition or leaching during the younger stage of the crystal's existence. Loss of ^{227}Ac through a recoil-related process is however permitted, as is uranium leaching from a radiation-damaged structure in older crystals. Although one relatively comprehensive set of results was available for a location within the dispersion fan, the significant age differences for some closely located crystals have suggested that the crystal formation must be spread in time ($0.7\text{-}0.3 \times 10^6$ years) as a result of unknown, possibly geochemical fluctuations. 3 refs., 4 figs.

13474 (INIS-mf–12779, pp. 79-101) **The distribution of uranium and thorium between phases in weathered core from Koongarra.** Edghill, R. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Jan 1990. 146p. In *Alligator Rivers analogue project: First annual report 1988-1989.* Order Number DE91618691. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents data for uranium and thorium concentrations, and $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ activity ratios in amorphous and crystalline phases of drillcore samples from the vicinity of the Koongarra uranium ore deposit. The amorphous material was defined as poorly ordered material accessible to, and therefore in approximate equilibrium with, the groundwater. Crystalline phases were defined as highly ordered materials with contained species inaccessible to the groundwater. Here amorphous material includes species absorbed onto the surface of crystalline phases. How the disequilibria and concentrations differ between the phases with the position of the sample, was also considered. The preliminary results suggests that a large proportion of the uranium and thorium is associated with the amorphous phase, which may include associations with ferrihydrite and adsorption onto iron oxides and clay minerals. The areas showing greatest leaching are near the top of drillhole DDH 52, whereas the most rapid accumulation seems to have occurred near the centre of the dispersion fan and near the

base of weathering to the edge of the fan. There is possibly preferential movement and accumulation of uranium just above the base of weathering. 17 refs., 1 tab., 4 figs.

13475 (INIS-mf–12779, pp. 135-142) **Geochemistry of ^{239}Pu, ^{99}Tc and ^{129}I.** Fabryka-Martin, J. (Los Alamos National Lab., NM (USA)); Curtis, D. Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia). Jan 1990. 146p. In *Alligator Rivers analogue project: First annual report 1988-1989.* Order Number DE91618691. Source: OSTI; NTIS (US Sales Only); INIS.

The occurrence of selected long-lived fission products (^{99}Tc and ^{129}I) and ^{239}Pu is being studied in solid and water samples. Methods of extraction of these isotopes from large volumes of groundwater have been developed, as well as methods for their measurement at the very low natural levels. Thus by directly measuring the neutron production rate on each ore sample and then using Monte Carlo Neutron/Photon Transport Code (McNP) to track the fate of these neutrons was possible to identify the critical elemental parameters controlling radionuclide production rates, and to test for expected correlations among product/target radionuclide pairs. The thermal component of neutron fluxes in uranium deposit appears to be quite small, with the vast majority of neutrons being absorbed in higher energy ranges. It is trerfore concluded that it is nearly impossible to estimate ^{239}Pu and ^{129}I concentrations and correlations by any simplistic calculations. In water from within and down-gradient of the deposit, ^{129}I/I ratios are higher by one to three orders of magnitude over background levels in the vicinity of the deposit. The down-gradient decrease is not systematic with distance from the orebody and probably reflects differing extents of dilution rather than sorptive losses. 1 tab., 2 figs.

13476 (INIS-mf–12784, pp. 186-192) **Factors controlling the distribution of radioactivity in south-eastern desert, Egypt.** El Rakaiby, M.M.L. (Nuclear Materials Corporation, Cairo (Egypt)); Kamel, A.F. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

The exploration for uranium and other nuclear materials in the eastern desert revealed the presence of a large number of significant radioactive anomalies in different types of rocks. The pink granites and related dikes such as fine grained granites and pegmatites proved to be the most significant uranium host rocks. The present work involves the study of six localities in the southeastern desert. These localities show promising radioactivity. It was found that the most radioactive fractures, in the studied localities are those trending NE-SW, NW-SE, E-W and N-S. Field measurements, of radioactivity in the different types of rocks are widely variable. It amounts to 200-300 cps. In the coarse grained granite, and 220-350 cps. in the fine grained granite, and 210-350 cps. in the bostonites, 270-450 cps. in the pegmatites and 150-300 cps. in the alpites. Anomalous readings were recorded where radioactivity reach a maximum of 4000 cps. in the fine grained granite of Um Ara, 1300 cps. in the bostonite of Um Ara, 5000 cps. in the pegmatites of El Hudi and 10,000 cps. in the pegmatites of Wadi El Arab. The other types of rocks show relatively low level of radioactivity.

13477 (INIS-mf–12784, pp. 201-207) **Radioactivity of the phosphate sediments of Abu Tartour area, western desert.** Kamel, A.F. (Nuclear Materials Corporation, Cairo (Egypt)); Mansour, S.E.I. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. Vol. 1. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003072. Source: OSTI; NTIS (US Sales Only); INIS.

Abu Tartour phosphate deposits form a part of the scarp face which bounds the Dakhla-Kharga depression in the western desert and occur at about 60Km to the west of Kharge town. A thickness between 17m and 57m of the phosphate deposit is developed in the central part of the scarp face. A total of 35 lithostratigraphic sections in the phosphate deposits were examined of which, 12 sections to the east of Abu Tartour phosphate mine, 22 sections to the west and one section at the locality of the mine. The phosphate bearing sediments belong to Dewi Formation, unconformably underlain by variegated sandy clays of the upper member of the Nubia Formation and conformably overlain by rocks of Dakhla Formation. The phosphate rocks are mostly of yellowish brown colour. Measurements of radioactivity showed that radioactivity varies from one deposit to the other. It ranges between 120 cps and 250 cps. The gravelly phosphate layers are the most radioactive. They have thickness 40-60cm and occur in the upper part of the section. Uranium content reaches up to 104 ppm.

13478 (LA-UR–91-638) **Soil vapor extraction enhanced by oscillatory flow.** Neeper, D.A. Los Alamos National Lab., NM (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9105136–2: 5. national outdoor action conference of aquifer restoration, Las Vegas, NV (USA), 13-16 May 1991). Order Number DE91008600. Source: OSTI; NTIS; GPO Dep.

The rate of contaminant removal by soil vapor extraction becomes low when diffusion limits the transfer of vapor from the soil to the channels in the soil where air preferentially flows. This paper suggests that adding an oscillatory component to the pressure and velocity of the subsurface air may increase the transport to the channels of flow, and thereby increase the rate of extraction, when the diffusion limit occurs. Three physical mechanisms by which oscillatory flow may increase the transport are described. Algebraic expressions and numerical estimates are given for the penetration of oscillatory pressure into various soils. Exploratory experiments with a laboratory soil column indicate enhanced extraction when an oscillatory component is superimposed upon nonequilibrium steady flow. 30 refs., 4 figs., 2 tabs.

13479 (LUNBDS-NBBE–90-1035) **Species of Al, Cd, and Cu in forest soil solutions: analytical methods, mobilization mechanisms and toxicity to plants.** Berggren, Dan. Lund Univ. (Sweden). Dept. of Ecology. Dec 1990. 21p. Order Number DE91753017. Source: OSTI; NTIS (US Sales Only).

The Donna dialysis and column cation exchange techniques were used to speciate Al, Cd, and CU in soil solutions from podzols and cambisols in S. Sweden, in order to improve the understanding of their mobilization mechanisms. On each soil type there were pure stands of Picea abies, Fagus sylvatica, and Betula pendula. Aluminium was mobilized mainly as an organic complex in the O, Ah, and E horizons of the podzols in the Picea abies and Fagus sylvatica stands. Also a significant fraction of Cd appeared to be organically complexed in these solutions. In the combisols and at 50 cm depth in the podzols, inorganic forms of Al and Cd were predominant. A pH dependent dissolution of solid-phase bound pool controlled the overall mobilization of Al in these soils and soil horizons. The relatively large organically bound solid-phase Al pool might be the source of this Al. Both solid-phase and solution chemistry suggest that cation exchange processes controlled the Cd^{2+} activities in the solutions. Organically bound Cu, estimated by the column cation exchange procedure, was most predominant in all soil solutions. At 15 cm depth, it constituted 90-98% of the total concentration. Humic substances probably were the most important ligands in these soil solutions. An experiment where Fagus sylvatic plants were exposed to nutrient solutions containing a total concentration of 0, 0.15, or 0.30 $mmol^{-1}$ of Al, with or without 300 mg fulvic acids L^{-1}, for 24 h, showed that Al complexed to fulvic acids was not available for the plants. The bioavailability was instead related to the concentration of inorganic mononuclear Al or to the Al^{3+} activity.

13480 (NEI-DK–493) **Two dimensional model calculations of water flow conditions in relation to deposits of desulfurization products.** Energiministeriets Energiforskningsprogram. Miljoe og restprodukter. Gregersen, J.; Hoegh Jensen, K. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. 1990 77p. (In Danish). Contract EM-1323/87-8. Order Number DE91752956. Source: OSTI; NTIS (US Sales Only).

EFP-87.

A two-dimensional unsaturated flow model developed by the U.S. Geological Survey was applied for simulating the flow in deposits of by-products from flue gas desulphurization. A hypothetical

sloping layered deposit was considered consisting of layers of 25 cm top soil and 80 cm sand on the top of various by-products. In the lower end of the sand layer a tile drain was introduced. Three different by-products were considered which all were assumed stabilized by adding sand and flyash. A laboratory investigation of the hydraulic properties of these by-products gave the following results. Porosity was in the range 50-60%, high capillarity with an air-entry value of the order 3.0 m, little hysteresis effect in the retention properties and saturated hydraulic conductivity in the range $4x10^{-8}$ m/s and $2x10^{-7}$ m/s. Model simulations of water flow and evapotransporation were carried out on the basis of one years data of rainfall and potential evapotransporation. The flow behaviour in the hypothetical deposites was found to be two-dimensional. Evapotranspiration from the top soil gave rise to a considerable reduction in deep percolation to the deposed by-products. Hereby leachate formation is reduced which is of potential risk to groundwater quality. Evapotranspiration was not affected by the slope of the upper layers. The distribution of the percolation out of the root zone on deep percolation and tile drainage outflow respectively was strongly dependent on both the hydraulic properties of the by-products and the slope of the layers. (AB).

13481 (OEFZS–4562) **^{137}Cs-activity concentration in milk two years after the Chernobyl accident compared to deposition rates.** Mueck, K.; Gerzabek, M.H.; Steger, F. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Nov 1990. 9p. Order Number DE91622595. Source: OSTI; NTIS (US Sales Only); INIS.

This paper was presented at the EC-Workshop 'Transfer of radionuclides in natural and semi-natural environments' in Passariano (IT), held 11-15 Sep 1990.

Due to large differences in precipitation levels in Austria at the time of the Chernobyl accident a wide range in ground deposition of Cs-isotopes was observed in Austria. Accordingly, large regional variations in the activity concentrations in foodstuff were observed. While in the first year on the accident the regional distribution of the activity concentration is practically identical with the deposition pattern, in the following years large discrepancies between food activity concentration and deposition levels are apparent. Milk was chosen as a sensitive indicator of activity concentrations in food and fodder as milk averages over a great number of animals and fodder area. ^{137}Cs-activity concentrations measured in large collective samples are compared to ground deposition of ^{137}Cs in that area. Ratios between milk activity concentration and deposition levels vary by more than a factor 10 with the highest ratios observed in extensively cultivated areas. These may be grouped into three categories with high, medium and very low fixation of Cs caused by soil type, but predominantly by organic content and depth of the soil profile. The reduction factor in ^{137}Cs-availability as indicated by the activity concentration in milk from first to third year amounted to 0,003 - 0,04 in most areas while in Alpine pastures only a minor reduction of less than 60 % was observed. (Authors) 12 refs., 3 tabs., 1 fig.

13482 (ORNL/RASA–89/19) **Results of the radiological survey at the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania.** Cottrell, W.D.; Crutcher, J.W.; Quillen, J.L. Oak Ridge National Lab., TN (USA). Jan 1991. 20p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008819. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the Formerly Utilized Sites Remedial Action Program, the US Department of Energy (DOE) is implementing a program to determine the radiological conditions at sites that were used to process radioactive materials under contract with the department's predecessor agencies. During 1955 the former Heppenstall Company site in Pittsburgh, Pennsylvania, was used by an Atomic Energy Commission contractor to process approximately 100,000 lbs of normal uranium metal. Because of insufficient records to document cleanup procedures and to verify the radiological condition of this site, DOE requested a survey. The radiological survey discussed in this report for the site of the former Heppenstall Company, Pittsburgh, Pennsylvania, was conducted by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory in July of 1989. The survey included a surface gamma scan of the warehouse, collection of indoor soil and dust samples and one outdoor sample, and measurement of direct and transferable alpha and beta-gamma activity. Results of this radiological assessment indicate no detection of radiation levels or radionuclide concentrations above DOE guidelines. 7 refs., 5 figs., 3 tabs.

13483 (PNL–7583) **Comparative simulations of a two-layer landfill barrier using the HELP Version 2.0 and UNSAT-H Version 2.0 computer codes.** Nichols, W.E. Pacific Northwest Lab., Richland, WA (USA). Jan 1991. 30p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008205. Source: OSTI; NTIS; GPO Dep.

This report documents the results of a simulation of the performance of a two-layer infiltration barrier for a nonradioactive dangerous waste landfill (NRDWL) at the US Department of Energy's Hanford Site in semi-arid southeast Washington State. The performance of the barrier was simulated for a period of 10 years using the UNSAT-H version 2.0 groundwater flow computer code. Pacific Northwest Laboratory performed this simulation to compare results using UNSAT-H 2.0 with those of the US Environmental Protection Agency's Hydrologic Evaluation of Landfill Performance (HELP) version 2.0 code. A conceptualization of the actual landfill barrier design was modeled using both codes. This model was simulated using 10 years of daily meteorological data collected at the Hanford Meteorological Station from 1979 through 1988. The intent of the comparison was to demonstrate that HELP conservatively predicts deep percolation of meteoric water at the Hanford Site. This demonstration required that the two codes be used to simulate the same conceptual model using identical, or at least essentially equivalent, input data. Comparing the results of the 10-year simulations showed that for the meteorological data and soil properties modeled the HELP 2.0 code was more conservative than the UNSAT-H code. HELP predicted a net drainage or deep percolation of 0.3592 cm (0.1556 in.) from the barrier for the 10-year period simulated. None to the UNSAT-H simulations predicted any deep percolation. HELP also predicted a greater proportion of precipitation returned to the atmosphere through evapotranspiration than did the UNSAT-H simulations in spite of the larger precipitation values being provided to HELP through an apparent data entry error. 14 refs., 11 figs., 8 tabs.

13484 (PNL–7618) **Acute environmental toxicity and persistence of DEM, a chemical agent simulant: Diethyl malonate: Final report.** Cataldo, D.A.; Ligotke, M.W.; Harvey, S.D.; Fellows, R.J.; Li, Shu-mei W.; Van Voris, P.; Wentsel, R.S. Pacific Northwest Lab., Richland, WA (USA). May 1990. 61p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009248. Source: OSTI; NTIS; GPO Dep.

The purpose of the following chemical simulant studies is to assess the potential acute environmental effects and persistence of diethyl malonate (DEM). Deposition velocities for DEM to soil surfaces ranged from 0.04 to 0.2 cm/sec. For foliar surfaces, deposition velocities ranged from 0.0002 cm/sec at low air concentrations to 0.05 cm/sec for high dose levels. The residence times or half-lives of DEM deposited to soils was 2 h for the fast component and 5 to 16 h for the residual material. DEM deposited to foliar surfaces also exhibited biphasic depuration. The half-life of the short residence time component ranged from 1 to 3 h, while the longer time component had half-times of 16 to 242 h. Volatilization and other depuration mechanisms reduce surface contaminant levels in both soils and foliage to less than 1% of initial dose within 96 h. DEM is not phytotoxic at foliar mass loading levels of less than 10 $\mu m/cm^2$. However, severe damage is evident at mass loading levels in excess of 17 $\mu g/cm^2$. Tall fescue and sagebrush were more affected than was short-needle pine, however, mass loading levels were markedly different. Regrowth of tall fescue indicated that the effects of DEM are residual, and growth rates are affected only at higher mass loadings through the second harvest. Results from in vitro testing of DEM indicated concentrations below 500 $\mu g/g$ dry soil generally did not negatively impact soil microbial activity. Short-term effects of DEM were more profound on soil dehydrogenase activity than on soil phosphatase activity. No enzyme inhibition or enhancement was observed after 28 days in incubation. Results of the earthworm bioassay indicate survival to be 86

and 66% at soil doses of 107 and 204 μg DEM/cm^2, respectively. At higher dose level, activity or mobility was judged to be affected in over 50% of the individuals. 21 refs., 10 figs., 15 tabs.

13485 (PNL-SA-19014) **Vitrified underground barriers.** Tixier, J.S.; Stottlemyre, J.A.; Murphy, M.T. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-910270-25: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008749. Source: OSTI; NTIS; INIS; GPO Dep.

In situ vitrification (ISV), a process for remediation of underground wastes, is now being developed to generate vitrified underground barriers. In this application, clean soil surrounding a waste site will be vitrified in order to isolate the wastes from undesirable contact or transport. Laboratory-scale experiments have demonstrated the following: (1) a subsurface ISV melt can be initiated and maintained, resulting in a horizontal, planar, glass block; (2) the downward growth of a vertical ISV melt can be directed and controlled such that enhanced melt rate and limited outward growth is achieved, resulting in a vertical, planar, glass block; and (3) a vertical ISV metal can be vitrified to a subsurface horizontal ISV block, forming a bond that joins them into one continuous formation. The results from these experiments demonstrate the feasibility of generating vitrified underground barriers beside, beneath, and/or around a waste site. This paper focuses on the experimental results and includes some discussion of the need for vitrified underground barrier technology and the course of the project. 3 refs., 9 figs., 1 tab.

13486 (PSI-83) **Batch sorption experiments with iodine, bromine, strontium, sodium and cesium on Grimsel mylonite.** Aksoyoglu, S. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Bajo, C.; Mantovani, M. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Dec 1990. 58p. Order Number DE91622525. Source: OSTI; NTIS (US Sales Only); INIS.

Promylonite surrounding the fracture at the migration site was not available in sufficient amounts, so mylonite from an adjacent fault zone was used. All the work has been carried out in glove boxes in a nitrogen atmosphere with very low O_2 and CO_2 levels. Mylonite was equilibrated with the natural Grimsel groundwater (NGW) prior to sorption experiments. The first series of sorption experiments was carried out without shaking. This caused sedimentation of the mylonite and led to slow kinetics. In the later experiments therefore, gentle, continuous agitation was used. No sorption of iodine and bromine on mylonite was observed under the experimental conditions used. It was observed that the sorption coefficient of ^{85}Sr and ^{22}Na were not affected by varying nuclide concentrations, provided these were kept much below their natural levels in NGW. This indicates that, in this nuclide concentration range, isotopic exchange takes place. Sorption coefficients did not vary with the rock/water ratio. Experiments with a bulky displacing cation suggested that some sodium ions were on less accessible internal sites and this could account for the slow kinetics for sodium. Further experiments with samples with smaller particle size confirmed this hypothesis. Batch sorption experiments on mylonite at initial cesium concentrations of between $3{,}2.10^{-8}$ and $5{,}0.10^{-4}$ M showed that sorption was reversible and non-linear; sorption coefficients were between 3800 and 21 ml/g. Increasing the potassium concentration in the solution led to reduced sorption of cesium, suggesting that Cs and K compete for the sorption sites. At the lowest Cs concentration used, sorption appears to be due to exchange with K at specific sites on mica, together with possible isotopic exchange. For these conditions and by making some assumptions, a Cs sorption coefficient for waters with different concentrations could be estimated.

13487 (UCRL-102799) **The precision of a fugacity-based model for estimating dermal uptake of chemicals from soil.** McKone, T.E. Lawrence Livermore National Lab., CA (USA). Oct 1990. 27p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9009293-2: 5. annual conference on hydrocarbon contaminated soils, Amherst, MA (USA), 24-27 Sep 1990). Order Number DE91008457. Source: OSTI; NTIS; GPO Dep.

Uncertainty about the predicted uptake of hydrocarbons from dusts and soils on human skin is addressed using a fugacity model. Methods available for sensitivity and uncertainty analysis are reviewed and assessed. A fugacity-based compartment model for dermal uptake from soil is presented. A major assumption of the uptake model is that soil on human skin behaves as a layer of soil particles mixed with air and water such that a tortuousity model applies. The possibility that soil instead attaches to skin as individual particles introduces uncertainty to the estimates of uptake derived from this model. In order to assess the magnitude of this uncertainty, the model is derived with and without the soil-layer assumption. Using 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and hexachlorobenzene (HCB) as test chemicals, a differential sensitivity analysis is applied to the layer and no-layer models in order to estimate the relative sensitivity of model output (uptake fraction) to all of the input parameters. A Monte Carlo simulation is used to carry out an uncertainty analysis in order to quantify the precision of the dermal-uptake prediction when applied to TCDD and HCB using both the soil-layer and no-soil layer assumptions. The predicted uptake fraction of HCB has an arithmetic-mean value of 0.15 and arithmetic standard deviation of 0.18; the predicted uptake fraction of TCDD has an arithmetic-mean value of 0.30 and arithmetic standard deviation of 0.28. 19 refs., 3 figs., 3 tabs.

13488 (Y/Sub-91-TJ997C/4) **Initial site characterization, environmental assessment, and corrective actions for underground storage tank 2315-U, Pine Ridge East Repeater Station, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee.** Eaton, J.M. (Science Applications International Corp., Oak Ridge, TN (USA)); Ingram, E.M. Oak Ridge Y-12 Plant, TN (USA); Science Applications International Corp., Oak Ridge, TN (USA). Feb 1991. 87p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OS21400. Order Number DE91009196. Source: OSTI; NTIS; GPO Dep.

This document presents the Initial Site Characterization Report and information to date regarding environmental assessment and corrective actions for Underground Storage Tank (UST) 2315-U at the Pine Ridge East Repeater Station, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee. This document was prepared following guidance in US Environmental Protection Agency (EPA) regulations promulgated under 40 CFR 280. The Pine Ridge East Repeater Station is located on Pine Ridge, which borders the Y-12 Plant to the north. One 64-gallon, asphalt-coated steel tank was located adjacent to the Repeater Station. This tank was used to store gasoline for the station's emergency power generator. Tank 2315-U was exempted from regulation under 40 CFR 280 and Tennessee Department of Health and Environment (TDHE) Rules 1200-1-15.-01 through 1200-1-15-.07 due to size and emergency generator exemptions. Because of an identified release discovered during initial corrective actions, TDHE requirements in revised Rule 1200-1-15-.06, promulgated April 15, 1990, regarding release response and corrective actions, apply to the site (TDHE, 1990). This report documents all activities, including initial abatement, initial site characterization, environmental assessment sampling, and corrective actions conducted to comply with TDHE regulations. Initial site characterization sampling data revealed that benzene, toluene, and xylene (BTX) concentrations exceeded applicable regulatory guidelines and lead values were elevated above levels expected for clean soils. 17 refs., 10 figs., 8 tabs.

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Refer also to citation(s) 12355, 12414, 12431, 12469, 12481, 12516, 12522, 12531, 12534, 12536, 12557, 12596, 12847, 13006, 13007, 13008, 13140, 13185, 13418, 13419, 13421, 13423, 13433, 13441, 13443, 13446, 13448, 13449, 13453, 13459, 13472, 13483, 13484, 13522, 13559, 13569, 13587, 13932

13489 (BSE-PROC-24) **Progress reports on cadmium, mercury, copper and zinc.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. 133p. Order Number DE91752984. Source: OSTI; NTIS (US Sales Only).

This publication consists of three Porgress reports on the harmful substances as follows: Progress Report on Cadmium, prepared by Sweden, Progress Report on Mercury, prepared by the Union of Soviet Socialist Republics and Progress Report on Copper and Zinc, prepared by the German Democratic Republic. There are differences in the origin and the age of the data from country to

country and substance by substance. The values are often very preliminary and rough, and therefore, it is obvious that the values should be used with great caution. Due to effective measures taken in the Baltic Sea States the amounts of harmful substances discharged vary from year to year. In some cases more recent data might be available in open literature and the users are advised to study also other sources of information.

13490 (BSE-PROC–27A) **Guidelines for the Baltic monitoring programme for the third stage: Part A. Introductory chapters.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1988. 60p. Order Number DE91752985. Source: OSTI; NTIS (US Sales Only).

The aim of the Baltic Monitoring Programme (BMP) is to follow the long-term (annual and long periods) change (trends) of selected determinands in the Baltic ecosystem. Monitoring data form a part of the background information for an appropriate assessment of the state of the marine environment and for a forecast of possible man-induced changes. The objective of the third and further stages is an optimization of the programme according to the experience gained and knowledge available in order to provide data for the preparation of more comprehensive assessments of the state of the Baltic marine environment. Bearing in mind that the Baltic Monitoring Programme in the open sea (outside territorial waters) is in general supplemented by national monitoring programmes and input studies in coastal waters. It is recommended that the determinands and methods included in the Guidelines should be used whenever possible. Part A contains general information on station networks, sampling requirements and data submission.

13491 (BSE-PROC–27B) **Guidelines for the Baltic monitoring programme for the third stage: Part B. Physical and chemical determinands in sea water.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. 71p. Order Number DE91752986. Source: OSTI; NTIS (US Sales Only).

The aim of the Baltic Monitoring Programme (BMP) is to follow the long-term (annual and long periods) change (trends) of selected determinads in the Baltic ecosystem. The objective of the third and further stages is an optimization of the programme according to the experience gained and knowledge available in order to provide data for the preparation of more comprehensive assessments of the state of the Baltic marine environment. Part B of the Guidelines for the third stage of the BMP contains methods for analyses of chemical determinands, such as heavy metals, petroleum hydrocarbons and chlorinated hydrocarbons, in sea water.

13492 (BSE-PROC–27C) **Guidelines for the Baltic Monitoring Programme for the third stage: Part C. Harmful substances in biota and sediments.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. 165p. Order Number DE91752987. Source: OSTI; NTIS (US Sales Only).

The aim of the Baltic Monitoring Programme (BMP) is to follow the long-term (annual and long periods) change (trends) of selected determinands in the Baltic ecosystem. The objective of the third and further stages is an optimization of the programme according to the experience gained and knowledge available in order to provide data for the preparation of more comprehensive assessments of the state of the Baltic marine environment. Part C of the Guidelines contains recommendations for only those species of organisms which are specifically selected for the BMP. However, sampling procedures have also been drawn up for selected coastal water species in order to enable comparability of the results obtained on the national level. The species chosen as test organisms and the sampling procedures recommended for monitoring harmful substances in biota are intended to provide a picture of the levels of harmful substances in the organisms studied, and to determine trends in their levels over time. Part C contains recommendations for the analytical procedures for mercury, cadmium, lead and chlorinated hydrocarbons in biological materials. Also analysis methods for contaminants in sediments are reported.

13493 (BSE-PROC–30) **Second seminar on wastewater treatment in urban areas.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. 215p. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Within the framework of the Helsinki Commission, a Second Seminar on Wastewater Treatment in Urban Areas was held in Visby, Sweden, 6-8 September 1987. Experts of Contracting Parties to the Helsinki Commission, both from the administrative and from the scientific fields participated in the seminar. In order to broaden the base for the seminar, participants from countries bordering to the North Sea were also invited. Topics of the seminar were about the quality of stormwater. Methods for estimation of the pollution load due to stormwater were also presented.

13494 (BSE-PROC–30, pp. 85-96) **Causes and effects of hazard from municipal - industrial agglomeration to the waters in the catchment area of the upper vistula.** Fiszer, J. (Technical University of Cracow (Poland)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Hazard to the natural environment in Poland was caused by excessive development of national economy and specially mining and heavy industry at simultanous underestimation of water and air protection. This may be accounted for by a rapid increase in population which has grown in the recent 40 years by about 12-14 mln. This was connected with the necessity of creating new work possibilities to assure work for people from the overpopulated country regions. Resources such as coal, zink and lead ore and sulfur occur in the South of Poland in the basin of the Upper Vistula where big municipal-industrial agglomerations developed. This caused difficulties in a planned protection of water against pollution at a lack of respective means. At present this problem is not only noticed by professionalists but also by economical and political authorities. There force inhibition of further degradation of the natural environment and gradual, though a long term, a melioration of this state is to be expected.

13495 (BSE-PROC–30, pp. 79-84) **Measures at or close to source to prevent the deterioriation of storm water quality.** Svensson, G. (VIAK Consultants, Goeteborg (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

The sources of the substances found in storm water can be divided into atmospheric sources and surface bound sources. Source control will be effective to reduce pollutants in: atmospheric fallout, exhausts from vehicles, and construction materials. Reducing runoff volumes is effective in reducing the pollution impact on surface water bodies. However, the risk of polluting the ground water must be observed. Means of reducing runoff volumes are: surface infiltration, percolation basins, and permeable asphalt. Surface maintenance is another effective way of reducing the pollution of storm water. This can be done by: street cleaning on a regularly basis, catch basin cleaning on a regularly basis, and snow transport. At present reducing storm water volumes and diverting some runoff to the treatment plant will be the most realistic way of handling the storm water pollution. Also, surface maintenance for industrial areas and restrictions for the handling of substances which could cause water pollution are effective tools. In the long run, source control may improve air quality, thus improving storm water quality.

13496 (BSE-PROC–30, pp. 65-74) **Slide rule methods for estimation of combined sewer overflow volumes and pollution load.** Farestveit, T. (State Pollution Control Authority - Norway, Oslo (Norway)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

This presentation on slide rule methods for estimation of combined sewer overflow starts by giving an overview of what kind of methods researchers have been using in predicting the pollution load and concentrations from overflow. So far no one has been able to give any good equation or method for calculating pollution load, and it would be useful to take a closer look into the nature of pollution deposits in combined sewers. The nature of the sedimentation in pipes and the wash out, is complicated to describe and predict. To predict the problem however it is possible to give some slide rules. Three major factors could be pointed out which should be resonable to measure or determine; the quality of the construction of the pipes, the slopecaracteristics, the dry weather flow and the geotechnical conditions. If the construction job is well done, like in tunnels, and the slope is steep enough to have self cleaning conditions, there should not be any problems at all with sedimentation in the sewers. If the slope is bigger than 10-15% there should not be too much problems with sedimentation. With lower slopes one must consider other parameters like the dry weather flow, the population density and the meter of pipe per person. If the dry weather flow is high, problems with deposits should not be too great. When it is lower one must look into other parameters like the slope and length of pipe and the length per person.

13497 (BSE-PROC–30, pp. 32-45) **The quality of urban storwater: a state-of-the-art review.** Ellis, J. (Urban Pollution Research Centre, Middlesex Polytechnic (UK)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

A review of pollutant sources and loadings discharged from both separate (SWO) and combined (CSO) sewers in urban catchments is made and scouring/resuspension of contaminated in-pipe and in-stream sediments is identified as a significant factor in the poor quality of urban sewer discharges. Receiving water impacts are discussed in terms of both acute and chronic timescale effects and exceedance criteria advocated as a basis for toxic bioassay analysis. The significance of both exposure and recurrence time for the establishment of wet weather criteria is stressed as well as the speciation of the toxicant.

13498 (BSE-PROC–30, pp. 12-31) **The eutrophication status of the Baltic Sea: input of nitrogen and phosphorus, their availability for plant production and some management implications.** Elmgren, R. (Univ. Stockholm (Sweden). Dept Zoology and Askoe Laboratory). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

The Baltic Sea has shown clear symptoms of nutrient enrichment in recent decades. This presentation is a short summary of this literature, focussed mainly on the Baltic Sea in a restricted sense, inside the Belt Sea and the Sound (= the Danish straits), with some preliminary consideration of likely future developments and of the management options available. It is possible to give only very rough estimates of where the nutrients added to the Baltic end up, since uncertainties in many terms tend to compound. The two main conclusions are: Most of the phosphorus load ends up in the sediment and most of the nitrogen load is denitrified. These conclusions emphasize the importance of sediment-water interactions in water bodies with long hydraulic residence time, such as the Baltic.

13499 (BSE-PROC–30, pp. 120-122) **Quality of stormwater - state of the art in Schleswig-Holstein.** Leymann, G. (Kiel (Germany, F.R.)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. (CONF-8709505–: 2. seminar on wastewater treatment in urban areas, Visby (Sweden), 6-8 Sep 1987). In *Second seminar on wastewater treatment in urban areas.* 215p. Order Number DE91752974. Source: OSTI; NTIS (US Sales Only).

Published in summary form only. URBAN AREAS/water pollution control; WASTE WATER; WATER QUALITY; RAIN; FEDERAL REPUBLIC OF GERMANY; RUNOFF; WATER POLLUTION; AIR POLLUTION

13500 (CEAC-R–7-90) **Multielemental analysis by neutron activation of sediments in the Ana Maria Gulf, Cuba.** Diaz Rizo, O. (Instituto Superior de Ciencia y Tecnologia Nuclear (ISCTN), La Habana (Cuba)); Gandarias, D.; Calzavilla, R.; Garcia, G. Comision de Energia Atomica, La Habana (Cuba). 1990. 18p. (In Spanish). Order Number DE91623298. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper general samples of marine sediments taken from six control stations of the Ana Maria Gulf (Cuba) were analyzed. For this purpose the thermal neutron activation analysis method was used. 18 elements were determinated. They are: Al, Ce, Co, Cs, Cr, Eu, Fe, Hf, La, Lu, Mo, Mn, Rb, Sc, Ta, Th, Yb and Zn. The accuracy varied between 5 and 30% for all elements. 10 refs.

13501 (DOE/EA–0474) **Environmental assessment of the interim groundwater treatment facility/land purchase at the eastern General Services Area of Lawrence Livermore National Laboratory, Site 300.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (USA). Feb 1991. 43p. Sponsored by USDOE,. Order Number DE91008352. Source: OSTI; NTIS; GPO Dep.

This Environmental Assessment (EA) describes the potential for environmental impacts from constructing and operating an interim groundwater extraction and treatment system in the eastern General Services Area (GSA) of Lawrence Livermore National Laboratory. A Remedial Investigation/Feasibility Study is currently underway at this site to determine how final cleanup activities will be conducted. The property to be acquired is used only for access to ground water monitoring wells for investigation of volatile organic compounds (VOC) contamination. The primary environmental impact from the purchase of this land would be the placement of the interim treatment system, thus, this Environmental Assessment primarily addresses the impacts of the treatment facility. The interim groundwater extraction and treatment system will capture and remove VOC-bearing groundwater from the shallow alluvial aquifer, treat it to remove the VOCs, and discharge the clean water to a portion of Corral Hollow Creek, where it will infiltrate back into the aquifer or evaporate. This interim action is intended to retard further migration of contaminants off-site and control the source of the plume. Interim cleanup would continue until all studies required by law and the regulators have been completed and the final remedy selection process completed. This document assess the effect of the proposed actions in floodplains/wetlands. 22 refs., 7 figs.

13502 (DOE/NV/10384–38) **Tritium variations in groundwater on the Nevada Test Site.** Lyles, B.F. Nevada Univ., Reno, NV (USA). Water Resources Center. Dec 1990. 93p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-85NV10384. Order Number DE91008907. Source: OSTI; NTIS; GPO Dep.

Publication No. 45086.

Twenty-five monitoring wells on the Nevada Test Site have been examined for tritium and other parameters on a periodic basis for the past 10 to 15 years. During this period of time, approximately half of the wells on the NTS exhibited tritium levels several times greater than background concentrations. However, many elevated concentrations were short-lived, and the tritium variations were poorly correlated to measured parameters, such as temperature, pH, and electrical conductivity. Statistical analyses (correlation and regression) and graphical analyses were used to interpret nearly 1900 tritium values from the 25 monitoring wells. Nearly half of the values were filtered from the database; tritium values below the analytical detection limit were filtered. Increasing trends were observed at UE7ns and Well A. The trends at UE7ns are interpreted as the result of breakthrough from the Bourbon test. The trend at Well A is less clearly understood, but may be the result of tritium migration from the vast nuclear tests in the area surrounding the well. Additional monitoring is needed. Three wells near Yucca Lake showed decreasing trends that appear to be associated with radioactive decay. A potential source for the initially elevated concentrations is rapid infiltration of rainfall runoff along cracks in Yucca Lake. However, a small amount of low concentration tritium

was injected at Well C and C-1 as part of a tracer test and may have contributed to the initially elevated levels. 17 refs., 15 figs., 10 tabs.

13503 (DOE/RL–91-04) **Quarterly report of RCRA groundwater monitoring data for period October 1, 1990 through December 31, 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 56p. Sponsored by USDOE,. Order Number DE91009346. Source: OSTI; NTIS; GPO Dep.

Hanford Site interim-status groundwater monitoring projects are conducted as either background, indicator parameter evaluation, or groundwater quality assessment monitoring programs as defined in the Resource Conservation and Recovery Act of 1976 (RCRA); and 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, as amended (EPA 1989). This submittal provides data obtained from groundwater monitoring activities for October 1, 1990 through December 31, 1990. Chemistry samples were not collected this quarter. The US Department of Energy-Richland Operations Office (DOE-RL) is currently in the process of awarding a contract to a suitable analytical laboratory. Resumption of sampling is anticipated in early 1991. Water level data have continued to be collected at each of the facilities. This report contains the water level measurements from 14 Hanford Site RCRA groundwater projects. The water levels were collected in accordance with the Hanford Site approved procedure found in WHC-CM-7-7 (WHC 1989). The measuring device was decontaminated before each series of measurements and after each well measurement to ensure the safety of personnel and to prevent cross-contamination of wells. Most facilities have not had any changes to their monitoring networks. Any changes made to monitoring networks for this period will be identified. 7 refs., 2 figs., 15 tabs.

13504 (DPST–88-375) **Radionuclide analyses of burial ground well water.** McIntyre, P.F.; Wilhite, E.L. Savannah River Lab., Aiken, SC (USA). 3 Jun 1988. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE91009306. Source: OSTI; NTIS; GPO Dep.

Radiological analysis of groundwater samples taken from grid wells in the 643-G burial ground of the Savannah River Plant, as well as several plume wells, cluster wells and background wells were performed during 1986 and 1987. Two series of sampling were performed. The first series of samples was collected during November 1986 and analyzed for strontium and plutonium (^{90}Sr, ^{238}Pu, ^{239}Pu) and gamma emitters. The second series of groundwater sampling was performed during February 1987. These samples were analyzed for long-lived beta emitting radionuclides carbon (carbon, strontium, technetium, and iodine – ^{14}C, ^{90}Sr, ^{99}Tc and ^{129}I) and stable iodine. In addition to ^{99}Tc and ^{129}I, this report documents the first analysis of groundwater below 643-G for ^{14}C. Throughout this report, comparisons are made with proposed EPA drinking water standards for radionuclides. The EPA drinking water standards do not necessarily apply to groundwater below the burial grounds. In addition, the samples were not collected and handled according to EPA protocols. Nonetheless, we have used these standards as a convenient benchmark for comparing results. 12 refs., 3 figs., 6 tabs.

13505 (ENEA-RT-AMB–90-19) **Natural water radionuclide sampler for chemical-physical properties and concentration determination.** Spezzano, P.; Giacomelli, R.; Bortoluzzi, S.; Montalto, M.; Nocente, M. ENEA, Saluggia (Italy). Centro Ricerche Energia. Oct 1990. 21p. (In Italian). (RT/AMB–90-19). Order Number DE91752933. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the realization of a sampler for the concentrating of radionuclides taken from large volumes of natural water with the purpose of determining their concentration levels and their physical-chemical forms. In this method, the sample is pumped at a flow rate of about 0.5 cubic meters/h through a set of sequential filters with different pore sizes to obtain the separation of 'particulate' from 'dissolved' forms. The filtered sample is then passed through sequential beds of cation and anion exchange resins and activated alumina to obtain the separation of dissolved forms on the basis of their charge. Ammonium hexacianocobalt ferrate (NCFC) is used as a selective exchanger for cesium isotopes. Filter and exchangers are measured by computerized gamma spectrometry. Detection limits are of a few tenths of Bq per cubic meter of sample. The main results obtained during radioecological surveys are also presented.

13506 (ETDE-mf–1754912) **ARW annual report 1989.** Arbeitsgemeinschaft der Rheinwasserwerke e.V. (ARW), Koeln (Germany, F.R.). 1989 246p. (In German). Order Number DE91754912. Source: OSTI; NTIS (US Sales Only).

The data of the development of the water quality of the Rhine River are described in continuation by a number of measured values. The observations and measurement results and the derived consequences are presented. (HP).

13507 (FMPC–2218) **Evaluation of EPA Region IV Standard Operating Procedures for decontamination of field equipment when sampling for volatile organic compounds.** Brice, D.A. (Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center); Kelley, M.E. Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center. [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-86OR21600. (CONF-9105136–1: 5. national outdoor action conference of aquifer restoration, Las Vegas, NV (USA), 13-16 May 1991). Order Number DE91008893. Source: OSTI; NTIS; GPO Dep.

Decontamination procedures for use at CERCLA sites where the US Environmental protection Agency (EPA) Region IV is the lead agency are specified in their Standard Operating Procedures (SOP) document. Under certain circumstances, the objectives of proper decontamination can be obtained without utilizing the full procedure as specified in the SOP. Because some treatment methods may introduce low levels of organic constituents into water (e.g., chlorination), the use of treated potable water would actually have an adverse effect on the decontamination procedure compared to the use of an untreated potable supply. Certified organic-free water, the cost of which ranges from five dollars per gallon to over sixty dollars per gallon may also be unnecessary in some cases. Distilled water samples from seven different suppliers (at a cost of less than a dollar per gallon) were analyzed for Target Compound List (TCL) volatile, organic compounds (VOCs) or benzene, toluene, ethylbenzene, and xylenes (BTEX). Fifty of the samples analyzed for BTEX contained no detectable amounts of these compounds, and twenty-six of the samples analyzed for TCL VOCs contained no detectable concentration. The use of solvent rinses may cause false positives during sampling. Field experiments have shown that isopropanol may degrade to acetone under some circumstances. In many cases, particularly when sampling ground water or decontaminating drilling equipment, the elimination of this step should not adversely affect sample quality. 8 refs., 1 fig., 3 tabs.

13508 (GSF-HY–1.90) **Annual report 1989 of the GSF Institute of Hydrology.** Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Hydrologie. Jun 1990. 299p. (In German). Order Number DE91759510. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations of the migration of natural isotopes in aquatic environments and the application of isotopic and chemical tracers to determine hydraulic characteristics are in the fore of the activities. The subject matter 'groundwater movement and harmful substance transport' presents model investigations, in particular concerning the disposal of radioactive substances and concerning carbonate geochemistry in groundwater and brine. This is followed by site-specific hydrogeologic and isotope-geochemical contributions. In the field of palaeoclimate, isotope analyses are carried out on tree rings. Novel apparative developments in measuring techniques concerning natural and artificial isotopic as well as chemical tracers are introduced. (DG).

13509 (Juel-Spez–547) **Areas with higher levels of natural radioactivity. Pt. 5. Radon sources in the Fichtelberg-Neubau area. Pt. 1: The two 'Maple' sources (Ahornquelle I and II).** Sansoni, B. (Kernforschungsanlage Juelich GmbH (Germany, F.R.). Zentralabteilung fuer Chemische Analysen). Kernforschungsanlage Juelich GmbH (Germany, F.R.). Zentralabteilung

fuer Chemische Analysen. Dec 1989. 61p. (In German). Order Number DE91759218. Source: OSTI; NTIS (US Sales Only); INIS.

The maple source I delivers 'radon containing water' for possible cure applications with sufficiently high radon concentrations of about 40 nCi Rn-222/l, extremely low concentration of radium and other solution containing materials, and is exceptional among radon medicinal baths used up to now for radon medicinal cures in the Federal Republic of Germany. Radon balneology is especially important for rheumatic diseases. It concerns a stimulation therapy also for chronic diseases which otherwise do not have any effect on it. From the view of radiation protection, medicinal cures with radon become justifiable if standpoints of radiation protection for artificial radioactivity is transferred correspondingly to natural radioactivity which has not been laid down by legislation up to now. Balneology and medicine are to prove the usefulness of medicinal cures with radon in a way that can stand the limits of statistics. Spa doctor and spa staff have to subject to a normal control for radiation protection. (orig./HSCH).

13510 (LUNBDS-NBLI–90-1020-112) **Effects of biotic and abiotic factors on the accumulation of radionuclides in Fucus vesiculosus L.** Carlson, Lena. Lund Univ. (Sweden). Dept. of Ecology. 24 Oct 1990. 112p. Order Number DE91623330. Source: OSTI; NTIS (US Sales Only); INIS.

Fucus vesiculosus has been used as an indicator for the occurrence of radionuclides in the marine environment. A prerequisite in using biological organisms as indicators is that the autecology of the organisms in question be well known. Growth, reproduction and individual biomass changes of tissues of different ages were studied in a Fucus vesiculosus population from the Oeresund, southern Sweden. The new vegetative fronds grown during the year accounted for about 80% of the total plant biomass in the autumn and this could affect the total activity concentration of long-lived radionuclides measured in whole plants of F. vesiculosus. Thus, a discharge of long-lived radionuclides during winter or spring gives a higher increase than a discharge during autumn. Differences in uptake and release of ^{54}Mn and ^{60}Co were observed between F. vesiculosus and its epiphytes but also between different tissues within the Fucus plant. Highest uptake and release were measured for the filamentous epiphyte Pilayella littoralis followed by the new vegetative fronds of F. vesiculosus after transplantation in situ from an area outside Barsebaeck nuclear power station, southern Sweden, to an area with low concentration of the radionuclides studied and vice versa. Salinity effects on the accumulation of radionuclides in F. vesiculosus were studied experimentally. Accumulation of ^{137}Cs, ^{54}Mn, ^{65}Zn and ^{60}Co was significantly higher in algae grown at 8 permille than at 15 and 24 permille, respectively. Most pronounced salinity effects were observed for ^{137}Cs. The impact of the Chernobyl accident was investigated in the Baltic Sea using F. vesiculosus. The Chernobyl accident contributed to the radioactivity in the Baltic Sea primarily concerning radiocaesium. (author).

13511 (LUNBDS-NBLI–90-1020-112, pp. 39-57) **Seasonal variation of radionuclides in Fucus vesiculosus L. from the Oeresund, southern Sweden.** Carlson, Lena (Lund Univ. (Sweden). Dept. of Ecology and Nuclear Physics); Erlandsson, Bengt. Lund Univ. (Sweden). Dept. of Ecology. 24 Oct 1990. In *Effects of biotic and abiotic factors on the accumulation of radionuclides in Fucus vesiculosus L.* 112p. Order Number DE91623330. Source: OSTI; NTIS (US Sales Only); INIS.

The activity concentrations of radionuclides (^{60}Co, ^{54}Mn, ^{137}Cs, ^{40}K) in whole plants of Fucus vesiculosus of different ages and also in tissues of different ages from the same plants were investigated in the vicinity of the Barsebaeck nuclear power plant in southern Sweden. Activity concentration differed between the tissues of different age of the plants, depending on the radionuclide as well as the time of year. The highest concentration of ^{60}Co and ^{54}Mn was measured in the older parts of the plants in spring and summer, while the activity concentration of ^{137}Cs and ^{40}K was highest in receptacles and new vegetative fronds. The discharge of radionuclides from the nuclear power plant was reflected in the measured activity concentration in the algae. For ^{60}Co the response seemed to be smoothed out when considering the whole plant, while the new vegetative tissue better reflected the discharge during the autumn. Thus, it is important to have knowledge about the autecology of the organism when it is used as an indicator for radionuclides. (authors).

13512 (LUNBDS-NBLI–90-1020-112, pp. 61-73) **Uptake and release of ^{54}Mn and ^{60}Co in Fucus vesiculosus L. and its epiphytes.** Carlson, Lena (Lund Univ. (Sweden). Lund Univ. (Sweden). Dept. of Ecology. 24 Oct 1990. In *Effects of biotic and abiotic factors on the accumulation of radionuclides in Fucus vesiculosus L.* 112p. Order Number DE91623330. Source: OSTI; NTIS (US Sales Only); INIS.

Fucus vesiculosus with epiphytic Pilayella littoralis was collected at a locality with low contamination of ^{54}Mn and ^{60}Co and transplanted at a locality in the vicinity of the Barsebaeck nuclear power plant in the Oeresund, southern Sweden and vice versa. The highest uptake of the radionuclides discharged from the nuclear power plant was observed in the filamentous epiphytic P. littoralis and difference in uptake of ^{60}Co was also observed between tissues of different ages in F. vesiculosus, with slightly higher uptake in the new vegetative fronds. P. Littoralis was succeded as epiphyte by Enteromorpha intestinalis and Cladophora sp. and the highest uptake of both radionuclides was observed in Cladophora sp. Compared with the native Fucus plants at Barsebaeck, the transplanted Fucus plants showed about the same activity concentrations of ^{54}Mn while the ^{60}Co concentrations in the transplanted plants were higher than in the native plants after about four months. The release of ^{54}Mn and ^{60}Co was most rapid in the epiphytic P. littoralis. Biological half-lives calculated from an exponential relation were found to be about 10 days for p. littoralis and about 40 days for new vegetative fronds of F vesiculosus. Longer half-lives were found for 1-year-old tissues of F. vesiculosus: about 95 and 165 days for ^{54}Mn and ^{60}Co, respectively. One year after transplantation about 30% of the initial activity concentration of ^{60}Co was still present in the older part of the F. vesiculosus plants. The differences in uptake of ^{54}Mn and ^{60}Co between the algal species illustrates the difficulties encountered in comparing results from different algal species. (author).

13513 (LUNBDS-NBLI–90-1020-112, pp. 95-111) **Radioactivity in the Baltic sea following the Chernobyl accident.** Carlson, Lena (Lund Univ. (Sweden). Dept. of Ecology and Radiation Physics); Holm, Elis. Lund Univ. (Sweden). Dept. of Ecology. 24 Oct 1990. In *Effects of biotic and abiotic factors on the accumulation of radionuclides in Fucus vesiculosus L.* 112p. Order Number DE91623330. Source: OSTI; NTIS (US Sales Only); INIS.

The brown alga Fucus vesiculosus L. has been used as a bioindicator for the investigation of the impact of the Chernobyl accident with respect to the spatial and temporal distribution of radionuclides in the Baltic sea. The investigations were performed in July 1986, about two months after the accident, and in August-September 1987. In July 1986 the gamma-emitting radionuclides ^{134}Cs, ^{137}Cs, ^{103}Ru, ^{106}Ru and ^{110}Ag^{m} were detected in F vesiculosus along the Swedish east, south and southwest coasts. The activity concentrations of ^{137}Cs varied from 600 Bq/kg dw at the northernmost locality (Simpnaes) to 20-25 Bq/kg at the south east cost. In August-September 1987 the activity concentrations of radiocaesium had increased with a factor 2-3 at most localities off the Swedish east coast, compared with the results from 1986. Regarding transuranics and ^{99}Tc the impact was small and we did not observe any increase of these radionuclides in the algae. The later effects of the radionuclide contamination in the Baltic Sea, primarily caesium, from Chernobyl were studied at one locality on the Swedish south coast from April 1987 to November 1988. A pronounced increase in the activity concentrations was observed during 1988 indicating an outflow of water, containing relatively higher levels of Chernobyl derived radionuclides, from the Baltic Sea. (authors).

13514 (LUTKDH-TKKT–1012-1-110-90) **A mass transfer approach to the dissolution of limestone.** Wallin, Mats. Lund Univ. (Sweden). Dept. of Chemical Engineering. 1990. 40p. Order Number DE91753029. Source: OSTI; NTIS (US Sales Only).

Film and penetration theories were used to model the dissolution rate of limestone in the CO_2-water system. The dissolution models are based on diffusion from a plane limestone surface into a stagnant solution and include the carbonate system acid-base reactions as well as the autoprotolysis of water. The mixing of the liquid is

described by hydrodynamic parameters which were experimentally determined. In the first stage, phase equilibrium was assumed at the limestone surface. This assumption is equivalent to the dissolution rate being fully determined by the rate of mass transfer. In stage 2 an empirical rate expression for the dissolution reaction was introduced. A comparison with other existing dissolution rate models was also performed. The dissolution models were analyzed both theoretically and by using dissolution experiments performed on rotating limestone cylinders and discs at different pH-values, CO_2-partial pressures, temperatures, rotational speeds and bulk concentrations of Ca^{2+}. In a 0.1 kmol/m^3 $CaCl_2$ bulk solution the analysis showed that up to the maximum pH-value investigated, pH=5.3, the dissolution process can accurately be described by any of the mass transfer models used. However in a CO_2 atmosphere, the penetration theory yields a slightly better correlation with experimental data. The enhancement effect of CO_2 and the temperature dependence are predicted by both of the models. The correlations between the rotational speed and the hydrodynamic parameter of each model were determined by fitting the dissolution models to the experimental data in a CO_2-free atmosphere via least-squares regression. In a calcium free bulk medium and pH-values greater than 4.4, the dissolution process was not fully described by the rate of mass transfer. A rate expression for the surface process was determined with use of the experimental data at high pH-values (pH>4.7) and no Ca^{2+} in the bulk solution. (author).

13515 (OCS/EIS/EA/MMS–90-0009) **OCS mining program Norton Sound lease sale: Final Environmental Impact Statement.** Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region. Mar 1991. 610p. Sponsored by Department of the Interior, Washington, DC (USA). Source: OSTI; Library/Public information Room, MMS, Alaska OCS Region, 949 East 36th Avenue, Room 110, Anchorage, AK 99508-4302.

This final environmental impact statement (FEIS) examines: (1) a proposal for leasing submerged Federal lands in Norton Sound for the recovery of gold and any other mineral recovered with gold or other mineral recovered using technology similar to that used for recovering gold; (2) four alternatives to the proposal; (3) the major issues identified through the scope process and through staff analysis; and (4) the mitigating measures considered as part of the proposal. 46 figs., 41 tabs.

13516 (ORNL/FTR–3868) **[International seminar on limnology]: Foreign trip report, February 17, 1991–February 24, 1991.** Kimmel, B.L. Oak Ridge National Lab., TN (USA). 5 Mar 1991. 20p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008913. Source: OSTI; NTIS; GPO Dep.

The traveler attended the Second Week on Limnology, the second of a four-part series of week-long conferences, which collectively will comprise the International Seminar on Limnology. These conferences are being organized and sponsored by the National Water Commission of Mexico for the purpose of upgrading the limnological knowledge, experience, and international contacts of limnologists, water resources scientists, and engineers in Mexico. This particular meeting focused on limnological research, water resources development, water resources problems, and lake restoration efforts occurring throughout the world. The traveler presented an invited lecture entitled "Understanding Reservoirs as Aquatic Ecosystems" and served as the moderator of a day-long session on "Selected Topics."

13517 (ORNL/M–1154) **Environmental surveillance data report for the first quarter of 1990.** Goldberg, P.Y.; Horwedel, B.M.; Osborne-Lee, A.E.; Powell, M.R.; Stevens, M.M.; Tardiff, M.F.; Valentine, C.K.; Wolf, D.A. Oak Ridge National Lab., TN (USA). Feb 1991. 90p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008552. Source: OSTI; NTIS; GPO Dep.

The Environmental Surveillance and Protection Section (ESP) within the Office of Environmental and Health Protection (EHP) at the Oak Ridge National Laboratory (ORNL) is responsible for the development and implementation of an environmental program to (1) ensure compliance with all federal, state, and US Department of Energy (DOE) reporting requirements to quantitatively demonstrate prevention, control, and abatement of environmental pollution; (2) monitor the adequacy of containment and effluent controls; and (3) assess impacts on the environment of releases from ORNL facilities. Monthly or quarterly summaries are presented in this report for each of the media sampled. The summary tables generally give the number of samples collected during the period and the maximum, minimum, average, and standard error of the average (SE) values of parameters for which determinations were made. This value is based on multiple samples collected throughout the period. It includes the random uncertainty, over time and space, associated with sampling, analysis, and the intrinsic variability of the media. 15 figs., 38 tabs.

13518 (PNL–7566) **Accuracy and cost effectiveness of manual and automated water-level monitoring technology.** Campbell, M.D.; Schalla, R.; Newcomer, D.R. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 44p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008817. Source: OSTI; NTIS; GPO Dep.

Relative water-surface elevations are used to characterize the unconfined aquifer beneath the Hanford Site. Simultaneous and frequent, measurements in areas of rapid change have been avoided because of cost, even though both are important, and in some cases essential, for aquifer characterization. The objective of this study was to evaluate, demonstrate, and report on the most cost-effective methods of obtaining water-level data for characterizing aquifers at hazardous waste sites. Aquifer characterization is needed to define hydraulic flow gradients, which determine rate and direction of contaminant transport. Such characterization requires accurate measurements of groundwater elevation. Automated datalogging equipment offers substantial benefits over manual measurements, including a lower cost per measurement. Staff at the Pacific Northwest Laboratory identified potentially suitable equipment and requested it from vendors for evaluation. Instrument performance was compared with manufacturer's specifications and laboratory requirements. Precision, accuracy, hysteresis, and short-term drift were tested. Test results are summarized in this report, and several suitable pieces of equipment were found. 3 refs., 22 figs., 1 tab.

13519 (UCRL-JC–105391) **Preliminary field demonstration of a fiber-optic TCE sensor.** Angel, S.M.; Langry, K.; Roe, J.; Colston, B.W. Jr.; Daley, P.F.; Milanovich, F.P. Lawrence Livermore National Lab., CA (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910123–13: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91008453. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed a differential-absorption fiber-optic sensor for use in groundwater and vadose zone monitoring of certain volatile organochlorines. The principle of detection is a quantitative, irreversible chemical reaction that forms visible light-absorbing products. The sensor has been evaluated against gas chromatographic (GC) standard measurements and has demonstrated accuracy and sensitivity sufficient for the environmental monitoring of trace levels of trichloroethylene (TCE) and chloroform. This sensor is currently under evaluation in monitoring well and vadose zone applications. In this paper, we describe the principles of the existing single measurement sensor technology and show preliminary field-test results. 3 refs., 8 figs.

13520 (WSRC-RP–90-778) **Compliance of the Savannah River Site D-Area cooling system with environmental regulations: Demonstration in accordance with Section 316(a) of the Clean Water Act, September 1988–February 1990.** Specht, W.L.; Mackey, H.E.; Paller, M.H.; Wike, L.D.; Wilde, E.W. (eds.). Westinghouse Savannah River Co., Aiken, SC (USA). Aug 1990. 175p. Sponsored by USDOE,. DOE Contract AC09-89SR18035. Order Number DE91007196. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents information relating to a demonstration under Section 316(a) of the Clean Water Act for the 400-D Area cooling system at the Savannah River Site (SRS) near Aiken, South Carolina. The demonstration was mandated because the National Pollution Discharge Elimination System (NPDES) permit for SRS (SC0000175), granted on January 1, 1984, specified in-stream temperature limits in SRS streams of 32.2°C and a ΔT limit of 2.8°C above ambient. To achieve compliance with in-stream

temperature limits, the Department of Energy (DOE) and the South Carolina Department of Health and Environmental Control (SCDHEC) entered into a Consent Order (84-4-W) which temporarily superseded the temperature requirements and identified a process for attaining compliance. The preferred option for achieving thermal compliance in Beaver Dam Creek consisted of increased flow, with mixing of the raw water basin overflow with the cooling water discharge during the summer months. Although this action can achieve instream temperatures of less than 32.2°C, ΔT's still exceed 2.8°C. Therefore, a 316 (a) Demonstration was initiated to determine whether a balanced indigenous biological community can be supported in the receiving stream with ΔT's in excess of 2.8°C. A Biological Monitoring Program for Beaver Dam Creek was approved by SCDHEC in June 1988 and implemented in September 1988. The program monitored the water quality, habitat formers, zooplankton, macroinvertebrates, fish, other vertebrate wildlife and threatened and endangered species in Beaver Dam Creek for an 18-month period (September 1988-February 1990). This document summarizes information collected during the monitoring program and evaluates the data to determine whether Beaver Dam Creek presently supports a balanced indigenous biological community. 97 refs., 32 figs., 51 tabs.

13521 (Y/SUB–91-YP507C/2-Pt.1) **Groundwater quality assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 plant: Groundwater quality data and calculated rate of contaminant migration.** Oak Ridge Y-12 Plant, TN (USA). Feb 1991. 282p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OS21400. Order Number DE91009197. Source: OSTI; NTIS; GPO Dep.

At the request of Martin Marietta Energy Systems, Inc., HSW Environmental Consultants, Inc. (HSW) has prepared this Groundwater Quality Assessment Report (GWQAR) for New Hope Pond (NHP) and several Solid Waste Management Units (SWMUs) located within the boundaries of the Department of Energy's (DOE) Y-12 Plant in Oak Ridge, Tennessee. Contained herein are the results of the assessment monitoring program obtained during the 1990 calendar year. Quarterly monitoring to assess the extent of anthropogenic compounds in the groundwater and their rate of migration has been in progress at NHP since 1987. The scope of the assessment monitoring program for NHP was expanded in 1989 to encompass the entire Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR), which was defined as the area extending from NHP to the West End of the Y-12 Plant. This change in scope was initiated because previous monitoring at NHP had confirmed the presence of groundwater contaminants in wells upgradient of the site, and monitoring in support of Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) indicated that SWMUs located within the Y-12 Plant Complex may be the source of these contaminants. 51 refs., 13 figs., 2 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 12872

5501 Behavioral Biology

Refer also to citation(s) 12596, 13866

5502 Biochemistry

Refer also to citation(s) 13143, 13179, 13535, 13536, 13538, 13539, 13540, 13543, 13555, 13571

13522 (DOE/ER/13736–T1) **The bioenergetics of salt tolerance: [Progress report].** Packer, L. California Univ., Berkeley, CA (USA). Dept. of Molecular and Cell Biology. [1991]. 6p. Sponsored by USDOE,. DOE Contract FG03-87ER13736. Order Number DE91008231. Source: OSTI; NTIS; GPO Dep.

The aims of this project was to try to understand the adaptive mechanisms that organisms develop in order to respond to a sudden transformation in their environment to a "salt shock." To study this problem we used a fresh water oxygenic photosynthetic cyanobacterium known as Synecoccus 6311. This organism suffers injury after this sudden exposure to high concentrations of sodium chloride equivalent to or even higher than that in sea water. Yet they are able to re-establish their photosynthetic activity which is partially injured and return to virtually normal growth rates. Identification of the temporal sequence of changes involved in adaptation to this stress was the rationale. Indeed this project employed a wide variety of biochemical and biophysical methods, including electron spin resonance techniques and nuclear magnetic resonance to study the bioenergetics and transport mechanisms, growth and energy changes in these organisms and how the structural components of the cells changed in response to adaptation to growth at high salinity. The problem has relevance for higher plants because most of the arable farmland in the world is already under use and that which is not used is usually in salite environments. Hence, understanding basic mechanisms of salt tolerance is a fundamental biological problem with great applications for bioproductivity and agriculture.

13523 (DOE/ER/13969–T1) **[A Center for the Study of Early Events in Photosynthesis]: Progress report.** Arizona State Univ., Tempe, AZ (USA). Dept. of Chemistry. [1991]. 23p. Sponsored by USDOE,. DOE Contract FG02-88ER13969. Order Number DE91008509. Source: OSTI; NTIS; GPO Dep.

The first 2 1/2 years of the Center have been very productive. Research completed by Center scientists has resulted in publication or acceptance of 60 papers, with several more currently under consideration. Individual project summaries are as follows: J. P. Allen is investigation molecular mechanisms of the reaction center, and influence of protein structure on the electronic properties of the primary electron donor. R. E. Blankenship is investigating the structure and function of chlorosome antennas in green photosynthetic bacteria. D. Brume is investigating the organization of chlorosomes and characterizing the role of proteins in chlorosomes. W. D. Frasch is studying the structure and mechanism of the two manganese requiring photosynthetic enzymes, the oxygen evolving complex and the energy transducing complex. D. Gust, T. A. Moore and A. L. Moore are investigating artificial photosynthesis systems where proteins have been replaced by covalent linkages between pigments molecules. S. H. Lin is developing a theory to explain photoinduced electron transfer and femto-second processes. G. R. Seely has developed a self-assembling model of primary charge separation in photosynthesis. W. F. J. Vermaas is optimizing site-directed mutagenesis studies of the acceptor side of photosystem 2. A. N. Webber is studying the biogenesis of photosystem 1 and 2 reaction center complexes in plants, green algae, and cyanobacteria. N. W. Woodbury is studying chimeric reaction centers and a reaction center symmetry mutant. 60 refs. (MHB)

13524 (DOE/ER/60395–T2) **Endonucleases involved in repair and recombination of DNA: Progress report, December 1, 1985–November 30, 1988.** Linn, S.M. California Univ., Berkeley, CA (USA). Dept. of Biochemistry. [1988]. 11p. Sponsored by USDOE,. DOE Contract FG03-86ER60395. Order Number DE91008269. Source: OSTI; NTIS; GPO Dep.

When our DOE support began as a contract in 1970, from the AEC, it was our intent to begin to understand how several enzymes which we had detected in E. coli might be involved in DNA recombination and repair. These studies led to our characterization of the recBC DNase (exonuclease 5) as well as endonucleases 3 and 5. As research supported by that contract progressed, we expanded our interests to include mammalian enzymes involved in base excision repair, most notably AP endonucleases, DNA glycosylases and DNA purine insertase. A logical next step involved the inclusion of DNA polymerases into our studies of repair. Current progress includes research on: isolation of xeroderma pigmentosum correction factors; isolation of ultraviolet (UV) endonucleases; mitochondrial repair enzymes; alkylation damage repair; comparisons of repair in normal diploid, transformed, and non-mitotic cells; and repair reactions by DNA polymerases.

13525 (DOE/ER/60687–T1) **[Normalized cDNA libraries]: Progress report.** Weissman, S.M. Yale Univ., New Haven, CT (USA). School of Medicine. [1991]. 6p. Sponsored by USDOE,.

DOE Contract FG02-88ER60687. Order Number DE91008513. Source: OSTI; NTIS; GPO Dep.

Four project are currently underway. First, we are generating a set of Not1 linking clones for analysis of the X chromosome. 105 different linking clones have been isolated, which is believed to be 60–90% of the total number of linking clones in the library. The average size of each clone is slightly more than one megabase. Second, we have applied the Polymerase Chain Reaction technique to generate deeper libraries of linking clones and also jumping clones. This technique offers important advantages over conventional jumping, such as the reduced DNA requirement. This technique can be used to generate chromosome specific linking (and possibly jumping) clones from sorted chromosomes. Third, to enrich for specific DNA fragments we initially used DNA probes and recA mediated homology searches, but in the past few years we've looked for an alternative selection approach. The technique developed has been to construct a sandwiched probe in which a short stretch of single stranded RNA links the biotinylated nucleic acid to the large fragment we wish to recover. Limited ribonuclease treatment gives a highly selective and very mild release step. Our major project has been to develop DNA libraries where all cDNAs are present in equal copy numbers. Since two-thirds of the mRNA in a representative cell is many copies of a small number of genes, normalizing all cDNAs can give a greater than 30-fold enrichment of low copy number genes. If the source of cDNAs is not a single cell, but rather a tissue of organism, normalization gives considerably greater enrichment. One approach to normalization describes is self-annealing, followed by a hydroxyapatite column to separate single stranded and doublestranded nucleic acids. Normalized libraries for human spleen and thymes are being developed. (MHB)

13526 (DOE/ER/60721–3) **Quasi-elastic neutron scattering studies of protein dynamics: Progress report, November 14, 1990–March 4, 1991.** Rorschach, H.E. Rice Univ., Houston, TX (USA). Dept. of Physics. 20 Mar 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER60721. Order Number DE91009515. Source: OSTI; NTIS; INIS; GPO Dep.

The techniques of X-ray and neutron scattering that have been so successfully applied to the study of the structure of biological macromolecules have in recent years been also used for the study of the thermal motion of these molecules. The diffraction of X-rays has been widely used to investigate the high-frequency motion of the heavy-atom residues of proteins. In these studies, the mean-square thermal amplitudes can be determined from the intensities of the sharp structural lines obtained from single crystals of the hydrated proteins. Similar information can be obtained on lighter atoms from the study of the neutron scattering from single crystals. The results of these measurements are coupled closely to the rapidly developing field of theoretical molecular dynamics which is now being applied to study the dynamics of large biological molecules. This report discusses research in this area.

13527 (LA-UR–91-361) **Time-resolved infrared studies of the dynamics of ligand binding to cytochrome c oxidase.** Dyer, R.B.; Peterson, K.A.; Stoutland, P.O.; Woodruff, W.H. Los Alamos National Lab., NM (USA). [1991]. 9p. Sponsored by USDOE, Washi. DOE Contract W-7405-ENG-36. Grant DK36263(WHW). (CONF-910123–6: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91007484. Source: OSTI; NTIS; GPO Dep.

Time-resolved infrared spectroscopy (TRIRS) has been employed to study the reactions of small molecules with the cytochrome a_3-Cu_B site of cytochrome c oxidase (CcO). All phases of these reactions have been investigated, from ultrafast phenomena (hundreds of femtoseconds) to relatively slow processes (milliseconds). The ligation dynamics immediately following photodissociation have been studied using a TRIR technique with time resolution of less than 1 ps. The rate of photoinitiated transfer of CO from Fe_{a3}^{2+} to Cu_B^+ was measured directly by monitoring the development of the transient Cu_B^+-CO absorption. The development of a stationary Cu_B^+-CO spectrum which is constant until the CO dissociates from Cu_B^+ occurs in less than 1 ps, indicating that the photoinitiated transfer of CO is remarkably fast. This unprecedented ligand transfer rate has profound implications with regard to the structure and dynamics of the cytochrome a_3-Cu_B site, the functional architecture of the protein and coordination dynamics in general. The photodissociation and recombination of Cn^- has also been studied using a real-time TRIR technique. The CN^- recombination rate of 430 s^{-1} is consistent with a recombination pathway similar to the one they have previously proposed for CO. The authors suggest the rate determining step for CN^- recombination is the thermal dissociation of the Fe_{a3}^{2+}-L bond. 25 refs., 7 figs.

13528 (LA-UR–91-510) **High-performance capillary electrophoresis of histones.** Gurley, L.R.; London, J.E.; Valdez, J.G. Los Alamos National Lab., NM (USA). [1991]. 28p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910293–1: HPCE '91: high performance capillary electrophoresis, San Diego, CA (USA), Feb 1991). Order Number DE91008585. Source: OSTI; NTIS; INIS; GPO Dep.

A high performance capillary electrophoresis (HPCE) system has been developed for the fractionation of histones. This system involves electroinjection of the sample and electrophoresis in a 0.1M phosphate buffer at pH 2.5 in a 50 μm x 35 cm coated capillary. Electrophoresis was accomplished in 9 minutes separating a whole histone preparation into its components in the following order of decreasing mobility; (MHP) H3, H1 (major variant), H1 (minor variant), (LHP) H3, (MHP) H2A (major variant), (LHP) H2A, H4, H2B, (MHP) H2A (minor variant) where MHP is the more hydrophobic component and LHP is the less hydrophobic component. This order of separation is very different from that found in acid-urea polyacrylamide gel electrophoresis and in reversed-phase HPLC and, thus, brings the histone biochemist a new dimension for the qualitative analysis of histone samples. 27 refs., 8 figs.

13529 (LA-UR–91-562) **Rapid sequencing of DNA based on single molecule detection.** Soper, S.A.; Davis, L.M.; Fairfield, F.R.; Hammond, M.L.; Harger, C.A.; Jett, J.H.; Keller, R.A.; Marrone, B.L.; Martin, J.C.; Nutter, H.L.; Shera, E.B.; Simpson, D.J. Los Alamos National Lab., NM (USA). [1991]. 12p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910123–16: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91008591. Source: OSTI; NTIS; GPO Dep.

Sequencing the human genome is a major undertaking considering the large number of nucleotides present in the genome and the slow methods currently available to perform the task. We have recently reported on a scheme to sequence DNA rapidly using a non-gel based technique. The concept is based upon the incorporation of fluorescently labeled nucleotides into a strand of DNA, isolation and manipulation of a labeled DNA fragment and the detection of single nucleotides using ultra-sensitive laser-induced fluorescence detection following their cleavage from the fragment. Detection of individual fluorophores in the liquid phase was accomplished with time-gated detection following pulsed-laser excitation. The photon bursts from individual rhodamine 6G (R6G) molecules travelling through a laser beam have been observed as have bursts from single fluorescently modified nucleotides. Using two different biotinylated nucleotides as a model system for fluorescently labeled nucleotides, we have observed synthesis of the complementary copy of M13 bacteriophage. Work with fluorescently labeled nucleotides is underway. We have observed and manipulated individual molecules of DNA attached to a microbead with an epifluorescence microscope. 16 refs., 3 figs., 1 tab.

13530 (UCLA–34P278-75) **Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1987–November 30, 1990.** El-Sayed, M.A. California Univ., Los Angeles, CA (USA). Dept. of Chemistry and Biochemistry. [1990]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-88ER13828. Order Number DE91009146. Source: OSTI; NTIS; GPO Dep.

During the past three years, a number of studies have been made to examine the different properties of bacteriorhodopsin and the effect of the different perturbations on its photocycle. A number of spectroscopic tools were used in these studies: (1) flash optical spectroscopy; (2) tryptophan fluorescence intensity, spectrum and decay; (3) time-resolved resonance Raman spectroscopy on the

femtosecond time scale; (4) circular and magnetic circular dichroism; and (5) differential scanning calorimetry. The different perturbations used include: (1) pH changes, (2) temperature changes, (3) removing metal cations, (4) removing the lipids, (5) adding anesthetic drugs (dibucane.HCl) to bacteriorhodopsin, and (6) mutagenic substitution of some amino acids. Some of the important conclusions of this work are summarized.

13531 (UCRL-JC-104229) **X-ray laser holography of biological microstructures.** Trebes, J.; Brase, J.; Gray, J.; London, R.; Matthews, D.; Peters, D.; Pinkel, D.; Stone, G.; Rosen, M.; Yorkey, T. Lawrence Livermore National Lab., CA (USA). 14 Jan 1991. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9009266--11: 2. international colloquium on X-ray lasers, York (UK), 17-21 Sep 1990). Order Number DE91008732. Source: OSTI; NTIS; GPO Dep.

The possibility of x-ray laser holographic imaging of biological microstructures is reviewed. The coherent energy output and pulse length necessary for achieving good three dimensional images of gold labeled human chromosomes is derived. 10 refs., 2 figs., 2 tabs.

5503 Cytology

Refer also to citation(s) 13523

5504 Genetics

Refer also to citation(s) 13523, 13525, 13529, 13555, 13571, 13911

13532 (CONF-900858--, pp. 199-202) **Microbial removal of organic sulfur from coal.** Kilbane, J.J. II. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The overall objective of this project is to use molecular genetics to develop strains of bacteria with enhanced ability to remove organic sulfur from coal, and to obtain data that will allow the performance and economics of a coal biodesulfurization process to be predicted. The general approach employed in this project is to obtain a pure microbial culture with documented ability to cleave carbon-sulfur bonds, to identify the genes whose products are responsible for carbon-sulfur bond cleavage, to enhance the expression of these genes, transfer the genes to other bacterial strains such as chemolithotrophs, and to use these improved bacterial cultures to desulfurize coal. A pure microbial culture, IGTS-8, has been isolated and documented to possess the ability to specifically cleave carbon-sulfur bonds in a range of organosulfur compounds. The biochemical characterization of IGTS-8 has been extensive. The genetic characterization of IGTS-8 has made significant progress; however, difficulties have been encountered. There is essentially no literature concerning genetic analyses of Rhodococcus rhodochrous; therefore, it is necessary to develop rather than merely utilize existing methodologies for genetic experiments involving Rhodococcus rhodochrous IGTS8. The chief limitation in the project at this time is the lack of a cloning vector that is capable of replicating/functioning in IGTS-8. This limitation is being addressed by the construction of a tailor-made cloning vector by fusing a small plasmid indigenous to Rhodococcus rhodochrous ATTC19067 to a well-characterized plasmid, pBR325, obtained from Escherichia coli.

13533 (CONF-900858--, pp. 203-210) **Cloning and expression of bacterial desulfurization genes.** Young, K.D. (Univ. of North Dakota, Grand Forks (USA)); Gallagher, J.R.; Denome, S.A.; Monroe, P.R. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

The goal of this project is to use the techniques of molecular genetics to identify, clone, sequence, and enhance the expression of enzymes that remove sulfur covalently bound to coal. This includes moving and expressing these enzymes in bacterial species that may be more useful in the industrial application of a biological desulfurization process. Four environmental isolates were obtained from Dr. Steve Krawiec of Lehigh University: three stains of Pseudomonas putida (A4, A15, B24) and one unidentified bacterium (C18). These he had previously identified by their ability to produce fluorescent products from the model sulfur-containing compound, dibenzothiophene (DBT). The work the authors have accomplished in the last nine months will be presented in four parts: assay evaluation, cloning of genes from strain C18, cloning of genes from strain A15, and identification of the products these organisms produce from DBT metabolism.

13534 (CONF-900858--, pp. 217-225) **Molecular genetic analysis of desulfurizing bacteria.** Fry, I.J. (Battelle Memorial Institute, Columbus, OH (USA)); Wyza, R.E.; Zupancic, T.J.; Palmer, D.T.; Litchfield, J.H.; Tuovinen, O.H. USDOE Pittsburgh Energy Technology Center, PA (USA). [1990]. From 6. annual coal utilization and environmental control contractors conference; Pittsburgh, PA (USA); 6-9 Aug 1990. In *Sixth annual coal preparation, utilization, and environmental control contractors conference. Proceedings.* 604p. Order Number DE91004208. Source: OSTI; NTIS.

Degradation of the organic sulfur in coal can be modeled using the compound dibenzothiophene (DBT). DBT metabolism in bacteria is thought to occur by two pathways (1) the proposed desulfurization (4S) pathway and (2) the oxidative or Kodama pathway. Dutt et al., (1988) at Lehigh University have reported the isolation of bacterial strains that express both the 4S and the Kodama pathways. These have been identified as Pseudomonas putida and some unidentified Gram-negative strains. It is the authors belief that the enzymatic systems responsible for the desulfurization of DBT could be beneficially altered in their specificity, control, transport and host characteristics by recombinant DNA manipulation to yield a bacterium that would be ideally suited for both inorganic and organic desulfurization of high sulfur coal in an industrial process. The experimental objectives in the molecular biological enhancement of coal desulfurization are as follows: (1) constructing cosmid libraries of the genomic and plasmid DNA of the Lehigh strains and screening for DBT degrading clones in P. putida; (2) identifying 4S and Kodama pathway genes by transposon mutagenesis of the Lehigh strains and the DBT degrading clones from the library (3) elucidating the enzymes involved in these pathways and their regulation; (4) altering DBT degrading genes by recombinant DNA technology to give functionally superior DBT degrading phenotypes; (5) transferring these genes by some means into a chemolithotrophic host such as Thiobacillus ferrooxidans and; (6) evaluating the engineered bacteria for coal desulfurization in a bioreactor. The current status of these tasks and future plans are described.

13535 (DOE/ER/12084--T1) **Nodulation gene factors and plant response in the Rhizobium-legume symbiosis: Final report.** Long, S.R. Stanford Univ., CA (USA). Dept. of Biological Sciences. [1990]. 11p. Sponsored by USDOE,. DOE Contract AT03-82ER12084. Order Number DE91008216. Source: OSTI; NTIS; GPO Dep.

Our original application aimed to identify genes outside the common nod region involved in nodulation and host range of alfalfa. This has been revised by adding other studies on nodulation gene action and removing molecular studies of gene action. Our restated goals and progress are as follows. An early goal was identification and characterization of additional nodulation genes. By means of transposon mutagenesis, mapping and marker exchange we have established 87 independent mutations in a 20kb area represented by plasmid pRmJT5. We discovered four new genes: nodP, nodD3, syrA and syrM. The sequence, start site and protein product for nodFe, nodG, and nodH were also identified. Regulation of nod FEGH was studied. nod FEGH can be induced by luteolin in the presence of noodle; nodD1; noD3 and syrM, a symbiotic regulator gene also increase transcription of nod FEGH. syrA will interact with syrM; syrM also regulates exopolysaccharide genes and is believed to be a master regulator. As part of these studies, an in vitro transcription/translation system for Rhizobium was developed. Adjacent to nodP we discussed nodQ, nodPQ occurrs in

two highly consumed copies. nodQ appears by sequence analysis to be similar to initiation and elongation factors, with the highest homology in the GDP binding domain. We have also investigated the nod strain, WL131. WL131 has an insertion, ISRm3, interrupting nodG, and a nonsase mutation in nodH, nodH is responsible for the lack of nodulation. We are currently investigating supernatant factors, host range effects C by spot inoculation, glucaronidase fusion proteins, and are developing, a single root hair inoculation protocol. 7 refs., 6 figs., 1 tab.

13536 (DOE/ER/13252–5) **Analysis of the *Rhizobium meliloti* surface: Final report.** Signer, E.R. Massachusetts Inst. of Tech., Cambridge, MA (USA). [1991]. 2p. Sponsored by USDOE,. DOE Contract FG02-84ER13252. Order Number DE91008977. Source: OSTI; NTIS; GPO Dep.

This project, originally oriented toward the role of the bacterial surface in nodulation and nitrogen fixation, has focused on rhizobial lipopolysaccharide (LPS). LPS mutants from R. meliloti strain SU47 were isolated by selecting bacteria resistant to bacteriophage or deoxycholate solubilization. The four best characterized, of the 13 groups obtained, all map to the bacterial chromosome. All mutants elicit Fix$^+$ nodules on alfalfa, giving little evidence for a role of LPS in symbiosis in R. meliloti, as opposed to other Rhicobium sp. exo mutants (reduced or eliminated extracellular polysaccharide (EPS)) elicit Fix$^-$ nodules on alfalfa, indicating EPS has a role in symbiosis. However, strain SU47 lacks the gene 1psZ, which can repress the Fix$^-$ phenotype caused by exo mutants. 1psZ$^+$ does not restore EPS, but instead alters LPS. This suggests that in R. meliloti, either EPS or a specific LPS conformation is required to generate Fix$^+$ nodules in alfalfa. Mutation at 1psX, 1psY, 1psI or 1psN prevent 1psZ$^+$ suppression of exo, presumably because all five genes (1psI, N, X, Y, Z) are required to obtain the proper form of LPS that can substitute for EPS. In support of the hypothesis, LPS from 1psX, 1psY, or 1psZ have characteristic structures, none of which match wild type LPS. 1psZ$^+$ has been cloud and sequenced. The 1psZ$^+$ protein has a predicted molecular weight of 48,589 and is probably cytoplasmic. 1psZ is constitutively expressed, and 1psZ$^+$ does not suppress exoC, suggesting the exoC product, phosphoglucomutase, may play a role in LPS processing. During this work, a host restriction difference between strains SU47 and Rm 41, inactivable by incubation 42°, was identified. (MHB)

13537 (DOE/ER/13518–5) **Determination of genes and phenotypes of bacteria necessary for epiphytic colonization and survival on plants: Annual progress report, 1990.** Lindow, S.E. California Univ., Berkeley, CA (USA). Dept. of Plant Pathology. [1990]. 16p. Sponsored by USDOE,. DOE Contract FG03-86ER13518. Order Number DE91008659. Source: OSTI; NTIS; GPO Dep.

Bacteria that live as epiphytes on the surface of healthy plants are important as plant pathogens, in causing plant frost injury by catalyzing ice formation, and in other processes. The objectives of this study are to determine the traits of these epiphytic bacteria which allow them to grow and/or survive in the hostile leaf surface environment. The genes and phenotypes of a strain of Pseudomonas syringae that are necessary for epiphytic fitness on bean leaves are being determined by an evaluation of the fitness and phenotypes of 5300 individual Tn5-induced insertion mutants. Attention is being placed on several mutants which exhibit no known phenotypic alteration, but which while growing normally on moist leaf surfaces succumb to the stresses associated with dry leaf surfaces, unlike the parental strain. Two genes from stress-sensitive epiphytic fitness mutants that have individually large effects on fitness have been identified in a cosmid library of the parental P. syringae strain by sequence homology to Tn5-containing fragments cloned from mutant strains. A 4.0 kb region subcloned from one cosmid restores the ability of mutant strains to survive drying stress on leaves. Fusions of these regions with a promoterless InaZ gene have been made to determine the regulation of transcription of these regions in situ by measuring the ice nuclei produced in merodiploid strains containing these fusion genes. An Ice$^-$ derivative of the parental P. syringae strain has been made by marker-exchange mutagenesis to allow measurements of ice nuclei in situ in these merodiploids exposed to different conditions on leaves. 11 figs., 1 tab.

13538 (DOE/ER/14037–T1) **Modifying K$^+$/Na$^+$ discrimination in salt-stressed wheat containing individual chromosomes of a salt-tolerant lophopyrum: Progress report, [1990].** Epstein, E.; Dvorak, J. California Univ., Davis, CA (USA). [1990]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-89ER14037. Order Number DE91008972. Source: OSTI; NTIS; GPO Dep.

As outlined in the proposal for this project, the practical or applied impetus for this research is this: salinity of soils and water is inimical to the production of crops and other plants biomass, and to that extent causes a dimunition of the world's capture of solar energy. Of the two strategies of coping with this problem – rendering soils and water less saline, and developing plants better able to cope with saline substrates – the present project deals with the latter. The current prolonged drought in California and elsewhere in the West prompts an energetic pursuit of this option, for the availability of less water is tantamount to a general exacerbation of the salinity threat. Bread wheat, Triticum aestivum, is relatively salt-sensitive, whereas tall wheatgrass, Lophopyrum elongatum, is highly salt-tolerant, as shown in our laboratory in investigations going back to the 1960's. In the present investigation both the degree of salt tolerance and that of K$^+$/Na$^+$ discrimination have been examined in wheat, Triticum aestivum, 'Chinese Spring,' the wheat x L. elongatum amphiploid, and a set of 20 disomic substitution lines. The latter would reveal which of the L. elongatum chromosomes substituted for their homoeologues in wheat contribute salt tolerance to wheat, and what congruence, if any, exists between that degree of salt tolerance and changes in K$^+$/Na$^+$ discrimination in the target wheat.

13539 (DOE/EV/70210–T2) **Studies of the repair of radiation-induced genetic damage in Drosophila: Final technical report, November 1, 1977–January 31, 1987.** Boyd, J.B. California Univ., Davis, CA (USA). Dept. of Genetics. 26 May 1987. 8p. Sponsored by USDOE,. DOE Contract AS03-76EV70210. Order Number DE91008041. Source: OSTI; NTIS; GPO Dep.

Twenty-four genes involved in mutagen sensitivity were discovered. Twelve were on the X chromosome, and 12 on chromosome 3. Six mutants were shown to alter chromosome segregation. Two mutants, mei-9 and mei-41, reduce meiotic recombination. mei-9 is also deficient in removal of pyrimidine dimers; mei-41 has a reduced capacity to synthesize DNA on a damaged template. Mutants at two new loci on the X chromosome were discovered. Thirty mutants were assigned to a dozen loci on chromosome 3. A new excision deficient mutant on chromosome 2 was analyzed. Application of repair deficient mutants to environmental mutagen screening was examined. Cell cultures of selected mutants were established for this purpose. Drosophila repair mutants which mimic human genetic diseases, and may provide model systems for those diseases, were identified. Attempts to clone the mei-9 and mei-41 genes are underway. The cytogenetic localization of mei-9 was refined to an area 100 kb from an entry point. An attempt was made to transposon tag the mei-41 gene to facilitate its cloning. Repair deficient mutants were obtained under conditions where the P transposable element should have been active. Two mutants were isolated – one has a P insert in or near the mei-41 locus, and the second is being probed for other transposable elements in the mei-41 region. In order to identify Drosophila repair genes homologous to human repair genes, a Drosophila Canton S library is being screened with a probe from the human clone ERCC 1. Three additional DNA repair projects have been completed. Hydroxyurea sensitivity of mei-41 mutants was examined. The kinetics of damage accessibility in Drosophila chromatin were analyzed. Finally, a mutant deficient in photo repair is being analyzed. 23 refs., 1 fig. (MHB)

13540 (LBL–30158) **DNA dynamics: From picoseconds to milliseconds.** Selvin, P.R. Lawrence Berkeley Lab., CA (USA). Nov 1990. 250p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009091. Source: OSTI; NTIS; GPO Dep.

Bending and twisting of DNA ocurrs during essential steps in genome organization and expression. Measuring these motions provides insight into DNA structure, its local environment and the mechanism of gene expression. DNA dynamics depend on important biological parameters, including topology, solute, solvent and

protein interactions. Time-domain optical techniques are the primary tools used in this study although development of an electron paramagnetic double-resonance technique has begun. These techniques allow measurements to be made from picoseconds up to approximately ten milliseconds, both in vivo and in vitro. "Naked" DNA undergoes rapid twisting motions well explained by theoretical models, as well as longer bending motions for which no quantitative theory exists. This forms a "baseline" for all further measurements. DNA under torsional stress induced by supercoiling is next examined. The bending constant of DNA does not change, whereas the torsional constant steadily increases as the DNA becomes more negatively supercoiled. The results can be explained by modelling DNA as a harmonic oscillator in bending and twisting, with an additional cubic perturbation to the twisting potential of 15% average magnitude. Preliminary results indicate that polyamines make the DNA more flexible, primarily through sequence independent, charge neutralization of the DNA-phosphate backbone. DNA complexed with protein in chromatin is found to be relatively free to move when only constrained by the lowest order of chromatin but greatly constrained by the higher order structure of chromatin and aggregation of these fibers. Motions of DNA in agarose gels with wavelength less than the gel pore size are relatively unhindered, whereas those larger than the pore size are damped out. 236 refs., 61 figs., 8 tabs.

5505 Metabolism

Refer also to citation(s) 13548

13541 (INIS-mf–12179) **Radiohistochemical investigations into the central nervous sialoglycoconjugate metabolism of dormice (Glis glis) in different stages of adaptation.** Mehlfeld, R. Hohenheim Univ., Stuttgart (Germany, F.R.). Fakultaet 2 - Biologie. 14 Jan 1988 129p. (In German). Order Number DE91754769. Source: OSTI; NTIS (US Sales Only); INIS.

Twenty adult dormice (Glis glis, Gliridae) were used to measure seasonal and temperature-related variations of sialoglycoconjugates in the central nervous system. The study had two different aims: On the one hand, biochemical and radiochemical methods of separation were used to investigate 10 cerebral regions for any changes in their individual contents of proteins and protein-bound sialic acids and for alterations in the ganglioside pattern of neurons as well as the time curves plotted for the uptake of a specific ganglioside tracer, 14C-N-Ac-mannosamine, that may possibly arise in response to seasonal and temperature-dependent adaptations. In addition, 32 central cerebral regions were examined for dormice showing different stages of adaptation (winter versus summer) to determine in autoradiograms that percentage share of integrated optical density (IOD), which accounts for the radioactively labelled proportions of TCA/PTA-soluble compounds, sialoglycolipids and sialoglycoproteins plus asialocompounds in the total radioactivity. (orig./ECB).

5506 Medicine

13542 (AM-R–9002) **Dynamic MRI reconstruction as a moment problem. Pt. 3: An error analysis of reconstruction by sinc and spline interpolation in a Hilbert space setting. Pt. 3.** Zwaan, M. (Centre for Mathematics and Computer Science, Amsterdam (Netherlands). Department of Analysis, Algebra and Geometry). Centre for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algebra, Analysis and Geometry. Jan 1990. 21p. Order Number DE91623352. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper a solution and an error analysis is given of a reconstruction problem that appears in magnetic resonance imaging (MRI), which is a diagnostic technique to measure and display cross sections of human organs. The reconstruction problem is solved in the setting of L^2-spaces of vector valued functions. After obtaining the solution, prove is given of error estimates and it is shown that the solution is stable for perturbation of the data and of the time markers. (author). 16 refs.

13543 (DOE/ER/60460–10) **Harvard–MIT research program in short-lived radiopharmaceuticals: Technical progress report paper No. 91-0-1.** Massachusetts Inst. of Tech., Cambridge, MA (USA). Mar 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER60460. Order Number DE91009050. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes progress on five projects. The first project showed a 1000 fold concentration of the cationic complex ^{99m}Tc (MIBI) in heart cell mitochondria vs heart cell cytoplasm, as determined by high resolution electron probe microanalysis. Additional technetium-99m based complexes are being developed and tested. The second project involves evaluating technetium acetylacteonates as potential indicators of cerebral blood flow. An intermediate in the synthesis of a technetium porphyrin complex has been synthesized; an oxotechnetium(V)-2,4-pentanedione complex has been prepared and is currently being characterized. The third project involves using radio labelled antibodies for diagnosis and treatment of cancer. An early discovery was that chloramine-T based iodination protocols resulted in a reversal of the charge on mouse IgGs. Immunoperoxidase-labelled monoclonal antibody MOv 18 was shown to bind specifically to the most frequent ovarian aderon carcinomas, and not to healthy tissue, making this antibody a good candidate for immunotherapy or immunodetection. Work on a specific immunotherapy protocol suffered a setback when one reagent, a ^{125}I-biotin complex, proved to be unstable in vivo. The fourth project involves labelling antibodies with positron emitting radionuclides. Radiofluorination was accomplished through reductive alkylation of ^{18}F-aldehyde, or pentafluorophenyl esters. Radioiodination was accomplished using alkyl-tin derivation exchange. The fifth project examined antibody modification for use in radioimmune imaging. Technetium-99m-labelled IgG was shown to be biologically equivalent to Indium-IIi-labelled IgG for imaging focal sites of inflamation. Also, Indium III labelling of small bioactive peptides was examined as a means of imaging important physiological processes. 44 refs., 2 figs.

13544 (DOE/ER/60972–1) **Synthesis and evaluation of boron compounds for neutron capture therapy of malignant brain tumors: Technical progress report, May 1, 1990–January 31, 1991.** Soloway, A.H. Ohio State Univ., Columbus, OH (USA). [1991]. 5p. Sponsored by USDOE,. DOE Contract FG02-90ER60972. Order Number DE91008452. Source: OSTI; NTIS; GPO Dep.

Current progress on this research includes the synthesis of chemical structures for malignant brain tumors. These structures include boron-containing derivatives of lipophilic anticonvulsants and CNS depressants; carboranyl precursors of nucleic acids and related structures; and carboranyl amino acids. Cellular uptake and persistence studies have also been carried out with F98 rat glioma cells. 1 fig., 1 tab.

13545 (INIS-BR–2388) **Iodized oil effects in the seric levels of thyroglobulin and in the thyreoid function parameters in patients with goitrous.** Lima Neto, N. Sao Paulo Univ., SP (Brazil). Faculdade de Medicina. 1987 101p. (In Portuguese). Order Number DE91622669. Source: OSTI; NTIS (US Sales Only); INIS.

Serum thyroglobulin (Tg) response to bovine TSH (bTSH) was evaluated in 44 goitrous patients (grades II and III), living in conditions of chronic iodine (I) deficiency (iodine urinary excretion < 40 μ I/g creatinin), and, in 26 normal subjects. After the initial clinical evaluation and laboratory tests (TSH, Tg, T sub(4), T sub(3), anti-Tg and anti-microsomal antibodiel) all goitrous patients received 1 ml i.m. of iodized oil (I-oil), and were followed up for 30 months. The bTSH test was repeated at 6, 12, 20 and 30 months after I-oil in 21 subjects. A marked reduction in goitre size was observed in 85% of the patients, with a concomitant significant increase in the mean serum T sub(4) and T sub(3) concentrations, significant decrease in the T sub(3)/T sub(4) ratio, and a significant fall in the mean serum TSH level. Goitrous patients had elevated serum basal Tg levels (55 +- 8 SEM ng/ml), and, a significantly mean higher peak Tg value after bTSH (200 +- 65 ng/ml) as compared with normal subjects (respectively, 11 +- 1.4 and 32 +- 3.4 ng/ml). Larger goiters (grade III) had a significantly higher mean peak Tg response as compared with grade II goiters. Treatment with I-oil significantly reduced the mean peak Tg response to bTSH after 6 months (59 +- 10 ng/ml), but at 12 and 20 months the peak Tg response after the injection rose, respectively, to 110 +- 19 ng/ml

and 92 +- 14 ng/ml ($p < 0.01$ as compared with 6 months), returning to the normal range only at 30 months (57 +- 11 ng/ml). The absolute increment δ Tg was also reduced significantly at 6 and 30 months but not at 12 and 20 months after I-oil. We conclude that two major factors may be involved in the increased secretion or release of Tg from the goitrous tissue: increased thyrotrophic stimulation and follicular derangement. Both events seemed to be corrected with the long-term action of I-oil. (author).

13546 (NIRS-M–75) **Radiobiological scope of cancer therapy: Approach to new radiation modalities.** Tsunemoto, Hiroshi; Ohara, Hiroshi (eds.). National Inst. of Radiological Sciences, Chiba (Japan). Nov 1989. 237p. (In Japanese). (CONF-8812153–: 20. NIRS symposium, Chiba (Japan), 8-9 Dec 1988). Order Number DE91755667. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers presented at the 20th National Institute of Radiological Science Symposium. The 19 of the presented papers are indexed individually. (J.P.N.).

13547 (NIRS-R–19) **Final report on the project research 'medical use of accelerated heavy ions': April 1984 - March 1989.** National Inst. of Radiological Sciences, Chiba (Japan). Mar 1990. 239p. (In Japanese). Order Number DE91755668. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers resulting from the title project. The 28 of the papers are indexed individually. (J.P.N.).

5507 Microbiology

Refer also to citation(s) 12298, 12299, 12300, 12357, 12645, 12945, 13522, 13523, 13532, 13533, 13534, 13535, 13537

13548 (DOE/ER/60556–T2) **Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds: Final report.** Bollag, J.-M. Pennsylvania State Univ., University Park, PA (USA). Dept. of Agronomy. Feb 1991. 14p. Sponsored by USDOE,. DOE Contract FG02-87ER60556. Order Number DE91008839. Source: OSTI; NTIS; GPO Dep.

Our interest in this research was mainly to compare the physiological characteristics of microorganisms derived from subsurface and surface environments and their ability to transform heterocyclic aromatic chemicals. We selected essentially indole and pyridine compounds as representatives of heterocyclic compounds. The samples investigated originated from the subsurface drillings at the Savannah River Plant, from surface samples in Pennsylvania, from municipal sewage of State College, Pennsylvania, and from pyridine-contaminated sites at Indianapolis. At different physiological conditions (aerobic, denitrifying, sulfate-reducing or methanogenic), different groups of microorganisms are active. Not only the thermodynamics of microbial physiology vary, but different metabolic pathways are used by the various types of microbial processes. Therefore, it was important to determine under which physiological conditions a compound was metabolized, and to clarify the metabolic conditions under which intermediate(s) were produced. 29 refs.

5510 Physiological Systems

Refer also to citation(s) 13541

13549 (ORNL/M–1040) **Reference physiological parameters for pharmacodynamic modeling of liver cancer.** Travis, C.C.; Arms, A.D. Oak Ridge National Lab., TN (USA). [1988]. 99p. Sponsored by Env. DOE Contract AC05-84OR21400. Order Number DE91008806. Source: OSTI; NTIS; GPO Dep.

This document presents a compilation of measured values for physiological parameters used in pharamacodynamic modeling of liver cancer. The physiological parameters include body weight, liver weight, the liver weight/body weight ratio, and number of hepatocytes. Reference values for use in risk assessment are given for each of the physiological parameters based on analyses of valid measurements taken from the literature and other reliable sources. The proposed reference values for rodents include sex-specific measurements for the $B6C3F_1$, mice and Fishcer 344/N, Sprague-Dawley, and Wistar rats. Reference values are also provided for humans. 102 refs., 65 tabs.

5530 Agriculture and Food Technology

Refer also to citation(s) 12578, 13535, 13536, 13537, 13538, 13577

13550 (AECS-PR/SS–14) **Calculation of radiation quantities for the medical products sterilization unit by gamma ray.** Othman, Ibrahim (Atomic Energy Commission, Damascus (Syria)); Ulwany, A.N. Atomic Energy Commission, Damascus (Syria). Jun 1990. 45p. (In Arabic). Order Number DE91623335. Source: OSTI; NTIS (US Sales Only); INIS.

Medical products sterilization unit using ^{60}Co will be in operation starting from in 1991, at the Atomic Energy Commission of Syria. The irradiator produced by USSR and exported by Technoexport. Intial activity of the ^{60}Co source is 100 Kci. In order to calculate the utilization factor, non-homogeneity factor, shielding, activity and exposure, a computure program written in BASIC language is used. The programe operates on version 3.2 MS DOS using IBM compatable microcomputers. 6 refs., 7 figs. (author).

13551 (CEAC-R–2-90) **The irradiation dose for the inhibition of the sprouting of Baraka variety potatoes.** Perez Rivero, B. (Instituto de Investigaciones de la Industria Alimenticia, La Habana (Cuba)); Salcines, R.; Prieto, E. Comision de Energia Atomica, La Habana (Cuba). 1990. 8p. (In Spanish). Order Number DE91623334. Source: OSTI; NTIS (US Sales Only); INIS.

Baraka variety potatoes graded in the packing house, were irradiated with doses of 0.08; 0.10; 0.15 and 0.20 kGy after a two weeks curing period. The potatoes were stored for five months at 12^0 +- 2^0C and relative humidity of 85 to 95%, and to determine the percentages of sprouting, rotting and loss in weight. It was concluded that doses of 0.08 kGy or more inhibited definitively the sprouting process. Less total losses and better commercial quality were obtained with a dose of 0.08 kGy the last of the store. 13 refs.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 12516, 12849, 13509, 13524, 13539, 13576, 13748, 13750, 13752

13552 (CNEA-NT–1/90) **Solution of moving boundary problems with implicit boundary condition.** Moyano, E.A. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Desarrollo. 1990. 28p. (In Spanish). Order Number DE91623308. Source: OSTI; NTIS (US Sales Only); INIS.

An algorithm that solves numerically a model for studying one dimensional moving boundary problems, with implicit boundary condition, is described. Landau's transformation is used, in order to work with a fixed number of nodes at each instant. Then, it is necessary to deal with a parabolic partial differential equation, whose diffusive and convective terms have variable coefficients. The partial differential equation is implicitly discretized, using Laasonen's scheme, always stable, instead of employing Crank-Nicholson sheme, as it has been done by Ferris and Hill. Fixed time and space steps (Δt, $\Delta \xi$) are used, and the iteration is made with variable positions of the interface, i.e. varying δs until a boundary condition is satisfied. The model has the same features of the oxygen diffusion in absorbing tissue. It would be capable of estimating time variant radiation treatments of cancerous tumors. (Author).

13553 (DOE/ER–0488P) **Radon Research Program, FY-1990.** USDOE Office of Energy Research, Washington, DC (USA). Office of Health and Environmental Research. Mar 1991. 263p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009356. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) Office of Health and Environmental Research (OHER) has established a Radon Research Program with the primary objectives of acquiring knowledge necessary to improve estimates of health risks associated with radon

exposure and also to improve radon control. Through the Radon Research Program, OHER supports and coordinates the research activities of investigators at facilities all across the nation. From this research, significant advances are being made in our understanding of the health effects of radon. OHER publishes this annual report to provide information to interested researchers and the public about its research activities. This edition of the report summarizes the activities of program researchers during FY90. Chapter 2 of this report describes how risks associated with radon exposure are estimated, what assumptions are made in estimating radon risks for the general public, and how the uncertainties in these assumptions affect the risk estimates. Chapter 3 examines how OHER, through the Radon Research Program, is working to gather information for reducing the uncertainties and improving the risk estimates. Chapter 4 highlights some of the major findings of investigators participating in the Radon Research Program in the past year. And, finally, Chapter 5 discusses the direction in which the program is headed in the future. 20 figs.

13554 (DOE/ER/60325–T1) **Activities of the National Academy of Sciences in relation to the Radiation Effects Research Foundation: Final report of progress, April 1, 1985–May 31, 1990.** Edington, C.W. National Research Council, Washington, DC (USA). Board on Radiation Effects Research. Feb 1991. 7p. Sponsored by USDOE,. DOE Contract AC01-85ER60325. Order Number DE91008206. Source: OSTI; NTIS; INIS; GPO Dep.

The activities of the National Academy of Sciences (NAS), in relation to the Radiation Effects Research Foundation (RERF), has a long history and the specific time period supported by this contract is but a small piece of the long-term continuing program. As a background, in August 1945, atomic bombs were dropped on Hiroshima (6 August) and Nagasaki (9 August). Shortly after the bombings, US medical teams joined forces with their Japanese counterparts to form a Joint Commission for the Investigation of the Effects of the Atomic Bombs. As a result of the Joint Commission's investigations, it was determined that consideration should be given to the establishment of a long-term study of the potential late health effects of exposure of the survivors to radiation from the bombs. The results obtained from RERF studies contribute the vast majority of information that provides a better understanding of radiation effects on humans. This information has been used extensively by national organizations and international committees for estimating risks associated with radiation exposures. The estimated risks developed by these independent organizations are used by government agencies around the world to establish standards for protection of individuals exposed in the occupational, medical, and general environment. Some of these results are described briefly in this report.

13555 (DOE/ER/60678–3) **Specificity of mutation induced by ionizing radiation and oxidizing free radicals: Progress report, April 15, 1988–April 14, 1991.** Strauss, B.S. Chicago Univ., IL (USA). Oct 1990. 9p. Sponsored by USDOE,. DOE Contract FG02-88ER60678. Order Number DE91008838. Source: OSTI; NTIS; GPO Dep.

The overall goal of this work is an understanding of the molecular mechanisms by which ionizing radiation damage is converted to mutation. We assume that induced mutation occurs as a result of DNA synthesis past damaged nucleotide bases (translesion synthesis). The mutational process can be dissected into three parts. If one considers a growing chain stopped just before a lesion, one can study an addition step in which a new base is aided opposite the damaged site, an elongation step in which additional bases are added to permit synthesis past the lesion, and an excision step which competes with the elongation step and results in removal of the added base. Polymerases have an inherent specificity in the absence of template and tend, in the absence of an instructional site or lesion, to add adenine nucleotides. This overall viewpoint accounts for a great deal of the published data on mutational specificity. There are three main conclusions from our work of the grant period, relevant to this hypothesis. First, suppression of 3′ → 5′ exonuclease activity provides additional time for the elongation reaction to occur. Second, ionizing radiation results in frame shift mutations at runs of pyrimidines as though non-instructive lesions were produced at these sites. Finally, ionizing radiation induced mutations produced as a result of base damage occur mainly at C's with a deficiency of base substitutions at the site of T's as would be expected if A's were inserted opposite damaged bases. 7 refs.

13556 (ENEA-RT-AMB–90-09) **Feasibility of individual intake Monitoring Program Based on ICRP Publication 54 criteria.** Melandri, C.; Battisti, P. ENEA, Casaccia (Italy). Area Energia, Ambiente e Salute. Oct 1990. 25p. (In Italian). (CONF-9003245–1: Giornata di studio sulla pubblicazione 54 dell'ICRP, Bologna (Italy), 6 Mar 1990; RT/AMB–90-09). Order Number DE91752931. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at Giornata di studio sulla pubblicazione 54 dell'ICRP (Bologna, 6 Mar 1990).

In the event that different methods of adequate sensivity are available, ICRP (International Commission Radiological Protection) Publication 54, 'Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretations' recommends the use of direct measurements in individual monitoring for intakes of radionuclides. This report analyses the possibility of performing the different controls on the basis of the proposed derived reference levels and respecting the accuracy requirements in the evaluation of individual intake and dose. General operative criteria are then defined by analysing the potentialities and limitations of the different whole body counters utilizable for measurements of the chemical, physical and metabolic characteristics of some radionuclides of particular interest in radiation protection. These criteria are useful for the planning of monitoring campaingns wherever there exists a radiocontamination risk.

13557 (INIS-mf–12178) **Influence of the gas atmosphere on the effects of sparsely ionising rays on synchronised CHO cells as determined from survival rates and DNA strand breaks.** Wolf, H. Goettingen Univ. (Germany, F.R.). Fachbereich Agrarwissenschaften (Landwirtschaftliche Fakultaet). 11 Jul 1985 138p. (In German). Order Number DE91754767. Source: OSTI; NTIS (US Sales Only); INIS.

Oxygen saturation and anoxia were the two extremes chosen to test the effects of three different kinds of sparsely ionising radiation (15 MeV electrons giving relative depth doses of 30% and 100%; 200 kV X-radiation) on synchronised 4n CHO cells in different phases of the cell cycle. A reciprocal relation between strand break repair and cell survival was only observed for the influence of the gas atmosphere, while no such correlation could be established for the cell cycle and quality of rays as the other two parameters tested. This means that the extent of DNA damage still to be seen after strand break repair cannot be regarded as the sole measure of cell survival. (orig./MG).

13558 (INIS-mf–12180) **Effects of split-dose irradiation of the rabbit's eye - a histopathological study.** Grabenbauer, G.G. Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet. 24 Feb 1987 68p. (In German). Order Number DE91754770. Source: OSTI; NTIS (US Sales Only); INIS.

Thirty-six rabbits were included in a study investigating into the effects of split-dose 300 KV X-irradiation on the cornea, ciliary body, nictitating membrane and lacrimal gland. In each animal, soly the right the eye was irradiated using total doses of 21 Gy, 30 Gy, 36 Gy and 45 Gy that were administered according to a fixed schedule in fractions of 3 Gy five times per week. After latency periods of six weeks, three months and six months the animals receiving 21 Gy, 30 Gy and 36 Gy showed no changes of the bulbi, eye lids and lacrimal glands that could be ascertained by histopathological evaluation. In the animals exposed to the 45 Gy dose, changes of the cornea and conjunctiva caused by radiation injuries to the lacrimal glands and conjunctival goblet cells started to appear after a minimum period of 3 months. This dose level was also the threshold for the occurrence of corneal damage or even ulceration as a result of secondary reduction or qualitative change of lacrimal secretions. (ECB).

13559 (Juel-Spez–536) **Areas with higher levels of natural radioactivity. Pt. 6. Discussion about the establishment of a radon spa in Fichtelberg-Neubau.** Bach, G. (Klinik Herzoghoehe der Landesversicherungsanstalt Ober- und Mittelfranken, Bayreuth (Germany, F.R.). Innere Medizin und Rheumatologie); Reul, K.; Sansoni, B. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Zentralabteilung fuer Chemische Analysen. Dec 1989. 44p. (In

German). Order Number DE91759217. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to the two maple sources I and II with 40.5 to 46.4 and 27.9 to 39.0 nCi radon-222/l respectively, a further nine sources of water containing radon of 10 to 25 nCi-radon-222/l are available in the region of Fichtelberg-Neubau. Seven of these sources supply radon containing water with about 18 nCi Rn-222/l. For a long time, the two maple sources I and II have been considered as the source for radon water to be used with a radon motion bath to be erected on the indoor swimming pool in Neubau. Further radon containing well waters are available to augment of the yield of the maple source I or for other application of radon water such as tub baths or even mineral water cures. Possible therapeutic indications and applications of the radon containing sources described as well as the sulphuric and ferroginous acescent element are discussed. The prospects for thermal exploratory boring for water are indicated.

13560 (KFK–4713) **Doses due to tritium releases by NET - data base and relevant parameters on biological tritium behaviour.** Diabate, S.; Strack, S. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Hauptabteilung Sicherheit; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. Dec 1990. 78p. Contract NET 89-195;364/89-2/FUD/NET. Order Number DE91759440. Source: OSTI; NTIS (US Sales Only); INIS.

This study gives an overview on the current knowledge about the behaviour of tritium in plants and in food chains in order to evaluate the ingestion pathway modelling of existing computer codes for dose estimations. The tritium uptake and retention by plants standing at the beginning of the food chains is described. The different chemical forms of tritium, which may be released into the atmosphere (HT, HTO and tritiated organics), and incorporation of tritium into organic material of plants are considered. Uptake and metabolism of tritiated compounds in animals and man are reviewed with particular respect to organically bound tritium and its significance for dose estimations. Some basic remarks on tritium toxicity are also included. Furthermore, a choice of computer codes for dose estimations due to chronic or accidental tritium releases has been compared with respect to the ingestion pathway. (orig.).

13561 (KURRI-TR–338, pp. 1-11) **Reactivity of pyrimidine nucleotides characterized by free radicals formed by hydroxy-attack.** Kuwabara, Mikinori (Hokkaido Univ., Sapporo (Japan). Faculty of Veterinary Medicine); Hiraoka, Wakako. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

Formation of free radicals by OH-radical attack on pyrimidine nucleotides (uridine 3'-monophosphate, poly(U), thymidine 5'-monophosphate, (deoxy)cytidine 5'(or 3')-monophosphate, poly(C)) was investigated by a method combining spin-trapping, ESR and high-performance liquid chromatography with special emphasis on the detection of their characteristic reactivity. For uridine- and thymine- related compounds, OH radicals reacted mainly with the base moiety to produce 5- or 6-yl radicals in the mononucleotide form. The similar reactivity of OH radicals to the base moiety was also observed in the polymer form. For cytosine-related compounds, OH radicals reacted with the base and sugar moieties to the same extent in the mononucleotide form, but reacted mainly with the sugar moiety in the polymer form to induce 4'-yl radical. The results indicate that when DNA is attacked by OH radicals the oxidative base damage is induced at the thymine base and the strand breaks are induced at the sugar moiety of nucleotide with cytosine. (author).

13562 (KURRI-TR–338, pp. 12-20) **Study of the initial processes of radiation effects using synchrotron radiation.** Kobayashi, Katsumi (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

Necessity for the research of production mechanisms of molecular damages in biological system and usefulness of monochromatic soft X-ray in these studies are described. Synchrotron radiation are introduced as a strong light source with continuous spectrum. Practically, it is the only light source in soft X-ray and vacuum UV region. Development of irradiation apparatus for radiation biology and recent results using various biological systems are reviewed. (author).

13563 (KURRI-TR–338, pp. 21-33) **Radiation-induced damages of DNA molecules and lethality in mammalian cells.** Okada, Shigefumi (Tokyo Univ. (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

Development of Radiation Chemistry enabled us to explain how ionizing radiations will inflict damages on molecules in living cells through direct actions and indirect actions. Among numerous molecular damages, those responsible for cell killing are DNA molecules. Types of DNA damages are single-strand breaks, double-strand DNA sicssions, sugar damages, base damages and non-reparable DNA damages. To identify the type of DNA damage responsible for cell killing, various modification were introduced for cell killing and types of DNA damages paralleled with modification are searched. Among these damages, 'non-reparable' DNA breaks are found to explain not only radioprotection and radiosensitization, but SLD repair, RBE, cell cycle dependency, and linear quadratic dose relationship. However, what are not explained are radiosensitive AT cells and PLD repair. 'Oxygen effect', an important phenomenon for cancer radiotherapy, could be explained by compmetitive reactions of DNA radicals with oxygen and cellular glutathion. (author).

13564 (KURRI-TR–338, pp. 34-41) **Analysis on the basic processes of biological radiation effects as probed by low-energy radiations.** Sasaki, Masao (Kyoto Univ. (Japan). Radiation Biology Center). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

The induction of chromosome aberrations was studied in human lymphocytes irradiated with monochromatic soft X-rays with quantum energy between 1.9 keV and 14.6 keV and fission neutrons with different energy spectra. The analysis of dose-response curves led us to a 'distance model', in which chromosome exchange aberration does arise as a consequence of pairwise interaction of DNA damages. While DNA is the prime target, the spatial proximity of the elemental chromatin fibers as vehicles of damage fixation as well as particle range rather than LET are of significant importance as the measure of biological radiation effects. (author).

13565 (KURRI-TR–338, pp. 42-49) **Radiation-sensitive mutants of mammalian cells.** Sato, Koki (National Inst. of Radiological Sciences, Chiba (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

Current topics on radiation-sensitive mutants of mammalian cells are described including cells derived from patients with repair-related hereditary disorders. A revertant of xeroderma pigmentosum cells poses problems concerning relationship between DNA damage and cell killing or mutagenesis. The discrepancy between enhanced chromosome breakage and normal repair of

double strand breaks appears to be solved by the proposal of misrepair in ataxia telangiectasia (AT) cells but the adequacy of selection has been disputed. Tow characteristics of AT cells, namely radiation sensitivity in terms of lethality and radioresistant DNA synthesis, part from each other in transformants with normal DNA and hybrids with normal cells. Radiosensitive mutants of rodent cells are also used for various experiments and several points of controversy have been discussed. (author).

13566 (KURRI-TR–338, pp. 50-56) **In vitro cell transformation by radiation.** Watanabe, Masami (Yokohama City Univ. (Japan). Faculty of Medicine). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

The transforming phenotypes gradually express during subculturing after treatment of chemical carcinogens. However, we have a few information about radiation-induced carcinogenesis. In this study, we investigated that the dynamics of expression of transforming phenotypes in X-ray induced transformants of golden hamster embryo (GHE) cells. GHE cells expressed several transforming phenotypes aster X-irradiation. Although morphological change was a transit phenotype expressed soon after X-irradiation, the only progeny of them expressed the other transforming phenotypes, such as anchorage-independent growth, immortality and tumorigenicity, during extensive subculturing in GHE cells. No transformants showed activation of any oncogenes by DNA transfection assay using NIH 3T3 cells. Numerical chromosome changes, however, may affect neoplastic progression and trisomy of chromosome 3 may play an important role in tumorigenicity. We also compared proteins of normal and transformed GHE cells with SDS-PAGE. Protein band with molecular weight of approximately 240 kDa (P240) were absent in transformed GHE cells. Thus, chromosome number and the expression of cellular proteins may be altered in radiation induced transformed cells. (author).

13567 (KURRI-TR–338, pp. 57-65) **Hierarchical structure of tissue and radiation effects.** Ijiri, Kenichi (Tokyo Univ. (Japan). Radioisotope Center). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jul 1990. (In Japanese). (CONF-9002170–: Symposium on radiation research in life science, Kumatori (Japan), 28 Feb - 2 mar 1990). In *Proceedings of the symposium on 'radiation research in life science': Mechanism of cellular and body damage induced by radiation.* 86p. Order Number DE91745056. Source: OSTI; NTIS (US Sales Only); INIS.

The epithelial cells lining the adult mammalian intestinal mucosa (villi and crypts) represent a hierarchical cell lineage that can be related to the tissue architecture. The spatial distributions of cell death (apoptosis) among the cells in the crypt of mouse small intestine after internal or external irradiation as well as after different drugs, show that each of the various cytotoxic agents tends to act preferentially over a characteristic small range of cell positions. Each agent tends to act with greatest efficiency on cells at a particular hierarchical position. The circadian rhythm also plays an important part in induction of apoptosis in such a tissue with a highly ordered hierarchical cell lineage. The peak time of day for inducing apoptosis was 06.00-09.00 h, and the trough occurred at 18.00-21.00 h. For such a rhythm, a possible explanation based on cell-cycle states of the target cell population for apoptosis (presumably stem cells) was drawn. The frequency of apoptosis after treatment with two colon carcinogens and radiation was studied in the crypts of five different portions of mouse bowel. When 1,2-dimethylhydrazine (DMH) was injected s.c., many apoptotic cells were found in the lower part of the large bowel, whereas few such cells were observed in the small intestine and the upper part of the large bowel. This finding was reversed in the case of radiation-induced apoptosis. (author).

13568 (LA–11948-MS) **Health-related effects of different ventilation rates in plutonium laboratories.** Fairchild, C.I. (Los Alamos National Lab., NM (USA)); Tillery, M.I.; Krause, F.R.; Gregory, W.S.; Lopez, R.C.; Bennett, J.B. Los Alamos National Lab., NM (USA). Jan 1991. 120p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. Order Number DE91008482. Source: OSTI; NTIS; GPO Dep.

The health-related effects of using different ventilation rates were studied in three plutonium laboratories. Experiments were conducted by measuring the dispersion rate, 3-dimensional distribution, and clearance rate of innocuous aerosols released at different locations and three different ventilation rates. Optimum air monitoring locations and alarm times, ventilation effectiveness, local concentrations, and mixing rates were determined vs ventilation rate and release location. Ventilation rate was found to be important to worker safety–higher airflow rates decreased contaminant concentration and clearance time, yet lower rates provided earlier detection of the release. Other comparisons of the effects of high vs lower ventilation rates are made. Concurrent with the experiments, a predictive, 3-D numerical code which simulated aerosol distribution vs time after release was developed and validated. 12 refs., 51 figs., 23 tabs.

13569 (PNL-SA–18892) **Analysis of risk indicators and issues associated with applications of screening model for hazardous and radioactive waste sites.** Buck, J.W.; Strenge, D.L.; Droppo, J.G. Jr. Pacific Northwest Lab., Richland, WA (USA). Dec 1990. 20p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910287–1: National research and development conference on the control of hazardous materials, Anaheim, CA (USA), 20-22 Feb 1991). Order Number DE91008258. Source: OSTI; NTIS; INIS; GPO Dep.

Risk indicators, such as population risk, maximum individual risk, time of arrival of contamination, and maximum water concentrations, were analyzed to determine their effect on results from a screening model for hazardous and radioactive waste sites. The analysis of risk indicators is based on calculations resulting from exposure to air and waterborne contamination predicted with Multimedia Environmental Pollutant Assessment System (MEPAS) model. The different risk indicators were analyzed, based on constituent type and transport and exposure pathways. Three of the specific comparisons that were made are (1) population-based versus maximum individual-based risk indicators, (2) time of arrival of contamination, and (3) comparison of different threshold assumptions for noncarcinogenic impacts. Comparison of indicators for population- and maximum individual-based human health risk suggests that these two parameters are highly correlated, but for a given problem, one may be more important than the other. The results indicate that the arrival distribution for different levels of contamination reaching a receptor can also be helpful in decisions regarding the use of resources for remediating short- and long-term environmental problems. The addition of information from a linear model for noncarcinogenic impacts allows interpretation of results below the reference dose (RfD) levels that might help in decisions for certain applications. The analysis of risk indicators suggests that important information may be lost by the use of a single indicator to represent public health risk and that multiple indicators should be considered. 15 refs., 8 figs., 1 tab.

13570 (RERF-TR–0-88) **Radiation Effects Research Foundation bibliography of published papers, 1988.** Radiation Effects Research Foundation, Hiroshima (Japan). 1989. 19p. (In Japanese, English). Order Number DE91755689. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the bibliography of the publication by the staffs of the Radiation Effects Research Institute (RERF) in 1988. Titles in original and English language with author names are enumerated. Indeces by research areas and by author name are also attached. (J.P.N.) 99 refs.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 12509, 13152, 13450, 13479, 13484, 13487, 13549, 13569

13571 (DOE/ER/60784–2) **Basic theory and methods of dosimetry for use in risk assessment of genotoxic chemicals: Annual technical progress report.** Ehrenberg, L.; Osterman-Golkar, S. Stockholm Univ. (Sweden). Dept. of Radiobiology. [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE

Contract FG02-89ER60784. Order Number DE91008992. Source: OSTI; NTIS; GPO Dep.

The continued work is planned to follow the lines indicated in the initial plan of September 28, 1987 and as sketched in the report for the second year. The work, interdisciplinary in character, will evaluate genetical, cytological, molecular-biological and chemical measurements with respect to relevance and sensitivity (resolving power) in risk estimation. The fact is being considered that human populations exhibit a strong variation in hereditary and acquired sensitivity to carcinogens and that, further, exposure to carcinogens may affect this sensitivity with deviations from linearity of dose-response curves in consequence. Several papers on these subjects are in preparation. We see it as a goal of the project to prepare a comprehensive review of the subject, with efforts to identify lines of research that could fill gaps in the present knowledge.

13572 (ETDE-mf--1754766) **Cadmium levels in the blood and renal cadmium excretion in patients with and without nephropathy as well as cadmium levels determined in hepatic and renal tissues as a measure of general exposure to cadmium in the Augsburg region.** Gilek, U. Muenchen Univ. (Germany, F.R.). Medizinische Fakultaet. 23 Feb 1988 89p. (In German). Order Number DE91754766. Source: OSTI; NTIS (US Sales Only).

The study is divided into two separate sections. One part deals with the effects of nephropathy on the cadmium concentrations in the blood and the excretion of cadmium with the urine. Parallel investigations were carried out (on a semi-quantitative basis) into the elimination of beta-2-microglobulin and total protein, which may provide a clue to any cadmium-related impairments of renal function. For this purpose, 187 patients with healthy kidneys were examined, among them 97 males (aged between 3 and 83 years) and 90 females (aged between 2 and 91 years). Another study group of 141 patients showing nephropathological findings was made up 91 men (age range 19-92 years) and 50 women (age range 20-93 years). In the second part of the study, the whole body exposure to cadmium was assessed for the population in the Augsburg region. In this connection, post-mortem examinations were carried out in 68 patients to measure the cadmium levels of the liver and kidneys. (MG).

13573 (ETDE-mf--1754768) **Influence of minerals supply on the 'acute yellowing' syndrome as well as on growth increment, pigment balance, photosynthesis, frost hardiness, and sensitivity to ozone in Picea abies (L.) Karst.** Hoepker, K.A. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Biologie. 19 Jul 1989 171p. (In German). Order Number DE91754768. Source: OSTI; NTIS (US Sales Only).

In this work the relevance of soil, soil-water balance (drought, waterlogging), tropospheric factors (air pollutants), and biotic factors (microorganisms) for the triggering of yellowing symptoms, biomass development, photosynthesis, the pigment balance, and frost hardiness in spruce was investigated. For this purpose a planting experiment was carried out where healthy tree-nursery material of different origin was planted in containers containing original soil from a yellowed spruce stand in the Bavarian Forest. Collaterally, the influence of minerals supply on ozone sensitivity in spruce was investigated in an ozone fumigation experiment. The influence of enhanced minerals supply on the 'acute yellowing' syndrome was additionally investigated in already ailing spruce material removed from its site. (MG).

13574 (HW-SA--2277) **Lead study---Lead in plastic, engineering and biological findings.** Skillern, C.P. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. Sep 1961. 10p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008868. Source: OSTI; NTIS; GPO Dep.

As technology improves, new materials appear in industrial processes. A new commercial product was used recently at the Hanford plant which, if used as recommended by the manufacturer would not cause much difficulty. When the material was burned with a welding torch, it became a dangerous health hazard. This material was lead in plastic. A welder and millwright were exposed to an excessive concentration of lead which was caused by the burning of a lead in plastic material. The lead concentration exceeded the Maximum Acceptable Contamination (MAC). Subsequent urine analysis indicated lead concentration at levels which exceeded that which has generally been used as an upper safe limit for urinary lead excretion. Burning the material on two plates, one stainless steel and the second lead, indicates that high lead concentration can be obtained. The concentration of lead in blood and urine decreased to a level below the MAC for lead in blood after removal of the individual from lead exposures. A commercial lead test sampling tube gave results which were above the MAC but did not indicate the magnitude of the exposure.

13575 (KFK-PEF--65) **Anthropogenic airborne dust in the ambient air of Baden-Wuerttemberg: Physical/chemical analysis and toxicological investigation.** Marfels, H. (Fraunhofer-Institut fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.)); Spurny, K.R.; Ibburg, J.; Wenzel, A.; Glaser, U.; Fritsche, U.; Otto, F.; Boose, C.; Koenig, J.; Balfanz, E. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). May 1990. 41p. (In German). Contract PEF 86/002/1C. Order Number DE91759516. Source: OSTI; NTIS (US Sales Only).

From 1986 to 1987 seven permanent measuring stations for aerodisperse dusts were set up at selected sites in Baden-Wuerttemberg (FRG). From January 1988 to March 1989 fibrous dusts, inorganic particles and organic substances were sampled every week on filters by means of special sampling devices; asbestos and other mineral fibers, acidity, ammonia, alkalines, alkaline earthes, 7 heavy metals, sulfate, nitrate, chloride, 17 PAH, 6 PCB and 6 PCPh were regularly analysed in mixed samples from 4 week sampling periods. Cultivated cells of different sensitivities were treated with selected dust extracts to find out potential carcinogenic and mutagenic effects of different compositions of dust depending on local and atmospheric conditions. It could be shown, that the cities Mannheim, Stuttgart and Karlsruhe had the highest concentrations for nearly all investigated pollutants. As compared to earlier measurements in Hamburg and in the Ruhr region the absolute concentrations of most components were 2 to 10 times lower in the industrial regions of Baden-Wuerttemberg. During extreme weather conditions comparably high concentrations of some heavy metals and several organic compounds were determined even in Baden-Wuerttemberg. This study tries to evaluate the obtained results with respect to their relevance for an epidemiologic risk assessment for the population. (orig.).

13576 (NUREG--1391) **Chemical toxicity of uranium hexafluoride compared to acute effects of radiation.** McGuire, S.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications. Feb 1991. 15p. Sponsored by Nuc. Source: OSTI; NTIS; INIS; GPO.

The chemical effects from acute exposures to uranium hexafluoride are compared to the nonstochastic effects from acute radiation doses of 25 rems to the whole body and 300 rems to the thyroid. The analysis concludes that an intake of about 10 mg of uranium in soluble form is roughly comparable, in terms of early effects, to an acute whole body dose of 25 rems because both are just below the threshold for significant nonstochastic effects. Similarly, an exposure to hydrogen fluoride at a concentration of 25 mg/m^3 for 30 minutes is roughly comparable because there would be no significant nonstochastic effects. For times t other than 30 minutes, the concentration C of hydrogen fluoride considered to have the same effect can be calculated using a quadratic equation: $C = 25\ mg/m^3$ (30 min/t). The purpose of these analyses is to provide information for developing design and siting guideline based on chemical toxicity for enrichment plants using uranium hexafluoride. These guidelines are to be similar, in terms of stochastic health effects, to criteria in NRC regulations of nuclear power plants, which are based on radiation doses. 26 refs., 1 fig., 5 tabs.

13577 (UCRL--21001-90-2) **Comparison of the response of mature branches and seedlings of Pinus ponderosa to atmospheric pollution: Annual progress report, [October 1989--September 1990].** Anderson, P.D.; Houpis, J.L.J.; Benes, S.E.; Neuman, L.E.; Loeffler, T.; Phelps, S.P. Lawrence Livermore National Lab., CA (USA). Jan 1991. 67p. Sponsored by Env. DOE

Contract W-7405-ENG-48. Order Number DE91008445. Source: OSTI; NTIS; GPO Dep.

Since completion of exposure-facility-construction activities in October 1989, most of our effort has focused on conducting the pollutant exposures and collecting plant-tissue response data. The winter and early spring months were spent calibrating the ozone generation and distribution system. Several modifications were made to the original fumigation system to mitigate problems with ozone generation. Acid-rain exposures were conducted as a series of rain events from June through August. Routine measurements of growth, foliage water potential, and soil-water content have been made since March. Intensive physiological measurements, including gas exchange, foliar-nutrient concentration, pigmentation, and antioxidant-enzyme activity were made in November (pre-exposure measurements), March, and July. Initial analyses fail to indicate significant ozone or acid-rain effects on many parameters. The gas-exchange data indicated that there may be a significant reduction in photosynthesis by mature-branch tissue in July due to ozone. The rates of transpiration, stomatal conductance, and photosynthesis were significantly greater for seedlings than for mature branches. Seedlings growing in Open-Top chambers had higher gas-exchange rates than seedings growing in Branch-Exposure Chambers during November and March, but the reverse was true in July. Pigment concentrations differed significantly among mature-tree families and among seasonal sampling dates. Antioxidant enzyme activities also varied with season of sampling, although there were no indications of a significant response to pollutant exposure. 27 refs., 21 figs., 7 tabs.

13578 (UCRL-JC-104810) **An introduction to biological dosimetry.** Mendelsohn, M.L. Lawrence Livermore National Lab., CA (USA). Oct 1990. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9010249-3-Rev.1: International symposium on trends in biological dosimetry, Lerici (Italy), 23-27 Oct 1990). Order Number DE91008991. Source: OSTI; NTIS; GPO Dep.

Biological dosimetry is the estimation of physical, chemical and biologically meaningful dose received from past exposures using observation of the biological subject or measurements on samples taken from the subject. It involves three interrelated things: a way to reconstruct or refine doses on the basis of the biological system's response; a general strategy to work through the complex sequences of events that bridge between an exposure and its ultimate biological effects; and an approach toward improving the predictive relationships between exposure and effects of concern. This study stresses the reconstruction and refining of dose, bridging between an exposure and its ultimate biological effect, and prediction and risk assessment. 1 tab. (FL)

5604 Other Environmental Pollutant Effects

13579 (IVO-A-01/90) **The physiological effects of 50/60 Hz electromagnetic fields: standards and guidelines.** Korpinen, L. (Tampere Univ. of Technology (Finland)); Partanen, J. Imatran Voima Oy (IVO), Helsinki (Finland). 1990. 94p. (In Finnish). Order Number DE91752996. Source: OSTI; NTIS (US Sales Only).

The Tampere University of Technology has started a study 'The Physiological Effects of 50/60 Hz Electromagnetic Fields'. The research is being financed by Imatran Voima Oy, Finnish Work Environment Fund and Tampere University of Technology. One of the objectives of this study is to examine standards and guidelines of different countries, concerning exposure to 50/60 Hz electric and magnetic fields. In German standard DIN VDE 0848 'Ssfety in electromagnetic fields' the limit of exposure to 50/60 Hz electric fields is 20 kV/m and the limit of exposure to 50/60 Hz magnetic fields is 5 mT. IRPA (International Radiation Protection Association) has compiled the interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. In these interim guidelines continuous occupational exposure during the working day should be limited to rms unperturbed electric field strengths not greater than 10 kV/m and to rms magnetic densities not greater than 0.5 mT. The duration of short-term occupational exposure to electric fields between 10 and 30 kV/m may be calculated from the formula t smaller than or equal to 80/E. Short-term occupational exposure to rms magnetic densities may not exceed 5 mT. Members of general public should not be exposed on a continuous basis to unperturbed rms electric field strengths exceeding 5 kV/m or to magnetic flux densities exceeding 0.1 mT. When the limits were compared with the measured values of electro-magnetic fields, it was found, that in Finland occupational exposure during the working day doesn't exceed the limits. The general public exposure doesn't exceed the limits either. Comparing the results of the studies with electromagnetic fields existing in Finland, it could be noticed, that short-term exposure doesn't cause health risks in Finland. Scientific studies don't indicate, that the continuous exposure causes health risks, neither, that the continuous exposure can't cause health risks.

57 HEALTH AND SAFETY

Refer also to citation(s) 12509, 13568

13580 (INIS-mf-12185) **Causes of disagreement and conditions of agreement in risk assessment.** Arbeiten zur Risiko-Kommunikation. Jungermann, H.; Wiedemann, P.M. Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Technik und Gesellschaft. Jan 1990 17p. (In German). Order Number DE91759396. Source: OSTI; NTIS (US Sales Only); INIS.

The intuitive, e.g. the estimation of a 'risk' which is not determined by a certain scientific method does obviously not only depend on the probabilities of occurring events and on the evaluation of the consequences of these events. There are further factors, the significance of which can be important for the estimation of the risk as well as for the risk behaviour. This is the topic in this article. At first cognitive determinants for estimating the probability and consequences are described, then further dimensions of the risk understanding are outlined, and finally appropriate steps are taken for the communication about technical risks. The study especially deals with the risk as function of probability and failure, characteristics of consequences, situation genesis as well as with risk and ambiguity. (orig./HSCH).

13581 (INIS-XN-286) **Code of practice for the design and safe operation of non-medical irradiation facilities (1988).** Australia. 1988 21p. Order Number DE91621707. Source: OSTI; NTIS (US Sales Only); INIS.

This Code establishes requirements for the design and operation of irradiation facilities which use X-rays, electrons or gamma radiation for non-medical purposes such as the sterilisation of therapeutic goods. These requirements aim to ensure that exposure of workers and members of the public to ionizing and non-ionizing radiation as well as to noxious gases and radioactive contamination of the environment and facilities are controlled through the design of engineering safety features, approved administrative controls and appropriate radiation monitoring.

58 GEOSCIENCES

Refer also to citation(s) 12397, 12398, 12435, 12437, 12470, 12479, 12483, 12487, 12499, 12510, 12512, 12513, 12514, 12532, 12533, 13349, 13396, 13397, 13398, 13399, 13400, 13402, 13403, 13421, 13453, 13477, 13508

13582 (CEA-DAS-739) **Engineering seismology application of a computer base comprise of french macroseismic data.** Godefroy, P. (Bureau de Recherches Geologiques et Minieres (BRGM), 75 - Paris (FR)); Levret, A.; Vaskou, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. 1990. 30p. (CONF-9009363-: 22. General assembly of the european seismological commission, Barcelona (Spain), 17-22 Sep 1990). Order Number DE91757107. Source: OSTI; NTIS (US Sales Only).

France, a moderately seismic country, has compiled a computer base of macroseismic data for the purpose of satisfying safety requirements implicated in its nuclear electric program. This evolving base includes not only information about the event and its epicenter, but also all the individual macroseismic observations. The

analysis of these data serves as an input to the deterministic assessment of seismic hazard for high-risk facilities. Current practice implements a seismotectonic approach wherein geological and seismic data are used to determine active faults or, when this is not possible, provinces shown to be homogeneous on the basis of a certain number of criteria. According to the safety procedure applied, the first step is to act as if this earthquake could occur at any spot within the entity to which it belongs, and thence at the point nearest the site. The maximum macroseismic intensity induced thereby on the site, either after displacing isoseismals or through use of laws of intensity attenuation versus distance, constitutes an initial level of seismic hazard with respect to which protective measures in the design of certain types of installation are taken. In the nuclear field, the regulations call for a second level of hazard, intended to afford an additional safety margin expected to cover, notably, uncertainties in the seismotectonic analysis or insufficiencies in the seismic data itself. This second level of hazard, designated Safety Design Earthquake, the effect of which is to raise the first-level intensity by one degree, is characterized by its response spectrum, in terms of which the facility's safety functions must remain unimpaired. Examples, drawn from south-eastern France, of the procedure just described will be presented.

13583 (CONF-8909163–Vol.2, pp. 206-220) **Bound water corrections to epithermal-neutron-derived water contents.** Burkhard, N.R. (Lawrence Livermore National Lab., CA (USA)); Hearst, J.R. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Water contents from epithermal neutron logs are used with bulk density and grain density data to calculate the porosity, gas-filled porosity, and saturation of the geologic media surrounding emplacement holes. The epithermal neutron log measures the total hydrogen content of the formation; the water content is calculated from that. However, the derived water content includes both bound and free water. Four methods have been examined to separate the total water content into free and bound water. The methods are: (1) determination of bound water from chemical formulae; (2) corrections based upon epithermal neutron response to standard minerals; (3) thermogravimetric analyses (heating) of samples; (4) empirical corrections derived from the logging data. There are fundamental difficulties with each method. The problem centers around deciding what is free water and what is bound water and/or what is really present in-situ. But when a correction for bound water is made to the total water content, the calculated properties are changed. Gas porosity will always increase; porosity and saturation will always decrease. A case example illustrating all four techniques is presented.

13584 (CONF-8909163–Vol.2, pp. 417-430) **Paleomagnetic evaluation of the Yucca-Frenchman flexure, southern Nevada.** Hudson, M.R. (Geological Survey, Denver, CO (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The eastern margin of the Yucca Flat basin, is bounded by north-northwest-striking tilted fault blocks of the Halfpint Range that curve as much as 900 clockwise into east-northeast strikes in the French Peak-Massachusetts Mountain (FPMM) area. This pattern of arcuate structures was termed the Yucca-Frenchman flexure by previous workers who attributed the arcuate pattern to clockwise drag along a proposed northwest-trending, right-lateral shear zone. Directions of remanent magnetization of the Ammonia Tanks and Rainier Mesa Members (about 11.5 Ma) of the Timber Mountain Tuff and of the Topopah Spring Member (about 13.5 Ma) of the Paintbrush Tuff were determined to assess vertical-axis rotation. After tilt correction, declinations of 30 site means obtained from the three ash-flow sheets in the FPMM area are more dispersed, but not systematically different than declinations of 12 site means from the Halfpint Range or declinations of 10 site means from little deformed reference areas to the west (Rainier and Pahute Mesas, Shoshone and northern Yucca Mountains). Paleomagnetic data indicate that structures in the FPMM area initiated with arcuate trends; not as originally straight elements that were rotated by right-lateral drag. The structures must have formed under the influence of locally different orientations and (or) ratios of principal stresses. The FPMM area lies in an accommodation zone between domains of predominantly west- and east-tilted Miocene and Pliocene extensional fault blocks to the north and south, respectively. The author suggests that local interaction between stress fields associated with fault zones that simultaneously propagated from north and south into the accommodation zone may have been responsible for the arcuate structures in the FPMM area.

13585 (CONF-8909163–Vol.2, pp. 431-455) **Structural relations within the paleozoic basement of the Mine Mountain block; implications for interpretation of gravity data in Yucca Flat, Nevada Test Site.** Cole, J.C. (Geological Survey, Denver, CO (USA)); Wahl, R.R.; Hudson, M.R. Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

The complex structure of the Mine Mountain block can be approximated as an irregular stack of east-tilted, tabular, fault-bounded sheets, composed of Silurian and Devonian carbonate rocks and less common Ordovician quartzite and Mississippian siltstone, that tectonically overlie clastic rocks of the Mississippian upper art of the Eleana Formation. Bedding and stratigraphic order within these sheets face either eastward or westward, and no simple relation describes the stratigraphic progression from structurally lower to structurally higher sheets. Intense shattering typifies the basal zone of each hanging wall block, whereas the tops of footwall blocks are commonly striated on large mullions, but little broken. If the exposed relations at Mine Mountain are extrapolated as a general structural model for the Paleozoic rocks of the area, then the distribution of rock types in the subsurface is much less predictable than with the Mesozoic thrust model. The traditional interpretation of Yucca Flat gravity data is that local gradients correspond to scarps (elevation discontinuities) in the buried top of the Paleozoic basement. The conservative approach for containment considerations requires that these scarps be inferred to mark the traces of high-angle faults. The Mine Mountain model, however, allows that lateral gravity gradients may be due to lateral density variations in Paleozoic rocks (resulting from the mid-Tertiary sliding), and may have no tectonic significance for the overlying volcanic and alluvial materials. Model calculations show that realistic assumptions for slide-sheet thickness and density contrast can account for observed gravity gradients for a range of burial depths.

13586 (CONF-8909163–Vol.2, pp. 457-482) **Paleostress investigation near Rainier Mesa, Nevada Test Site.** Minor, S.A. (Geological Survey, Denver, CO (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 2.* 482p. Source: OSTI; NTIS.

Knowledge of the fault-kinematic and paleostress histories in the Rainier Mesa/Yucca Flat region can be beneficial to containment scientists in understanding the effects of natural faults on containment of nuclear detonations. Fault-slip data were collected from 444 small-displacement (0.1-10 m) faults cutting 16-11 Ma tuffs and tuffaceous sedimentary rocks in nine areas mainly along the south, east, and northeast flanks of Rainier Mesa to investigate the faulting and paleostress history in the region. From cross-cutting relations of faults and faulted stratigraphic units, the relative age of many of the computed stress regimes and associated faults were determined. Using stratigraphic constraints and similarities in stress results, a relative stress-regime and faulting sequence was constructed for the study region. Interpretation of these data and results give the tectonic history which follows.

13587 (DOE/ER/60348–T2) **WINTER '90 Hydrographics Data Report: CTD station profiles, sections, nutrients, SAIL,**

January–February 1990. Chandler, W.S.; Atkinson, L.P. Old Dominion Univ., Norfolk, VA (USA). Research Foundation. Jan 1991. 255p. Sponsored by USDOE,. DOE Contract FG05-85ER60348. (TR–91-2). Order Number DE91008286. Source: OSTI; NTIS; GPO Dep.

The WINTER '90 Hydrographic Data Report includes CTD (conductivity, temperature and depth) data listings and profile plots of each station taken aboard the R/V Cape Hatteras from 27 January–9 February 1990. This report also contains vertical section contour plots, time series contour plots, nutrient, chlorophyll, and SAIL (Shipboard Serial Ascii Instrumentation Loop) data. The Winter 90 cruise further tested our ideas of shelf break processes. These ideas were based on the GALE observations in January 1986. During those observations we discovered that intense southward winds and heat loss caused onshore flow of nutrients and enhanced production. GALE was primarily a meteorological and oceanographic study with limited biological observations. Winter 90 repeated the GALE experiment with added chemical and biological measurements. 5 refs., 3 figs.

13588 (DOE/ER/60555–4) **Transport and transfer rates in the waters of the continental shelf and slope: SEEP.** Biscaye, P.E.; Anderson, R.F. Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory. Dec 1990. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER60555. (COC–60555-1). Order Number DE91009350. Source: OSTI; NTIS; GPO Dep.

At this writing we are in the midst of the first year of the present funding period. This period was approved as a three year grant, but, with the planned restructuring of the DOE regional programs, it will undoubtedly be less than that. With the exception of some relatively minor participation in connection with the French ECOMARGE programme and finishing of some work on SEEP-1 samples, all of our efforts in the current year have been in the preparation and analysis of samples and data obtained during the SEEP-2 field experiment in 1988–1989. We review briefly the progress on these sediment trap samples and transmissometer data at present and the status anticipated at the end of the current funding year with respect to the several kinds of analyses planned for them. We also briefly review the status of the last of the work on SEEP-1 samples and data, and of our participation in other collaborative projects. 14 refs.

13589 (DOE/NV/10845–4) **Development of methodologies for the identification of flood hazard zones along potential rail access corridors to the Yucca Mountain Site: Annotated bibliography.** French, R.H.; Preator, L.; Nicholson, R. Nevada Univ., Reno, NV (USA). Water Resources Center. Feb 1991. 49p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-90NV10845. Order Number DE91008908. Source: OSTI; NTIS; GPO Dep.

The overall goal of this project is the development and application of methodologies for the identification of flood hazard zones along potential rail access corridors through Nevada to the Yucca Mountain Site and to provide information that will assist the railroad drainage structure design engineers. An initial objective objective of this project was the development of an annotated bibliography that defines the state-of-the-art in the identification of flood hazard zones and the design of flood protection facilities in the arid and semi-arid environment. The types of documents reviewed in the preparation of this bibliography included standard hydrologic and hydraulic engineering design manuals, engineering reports, and the peer-reviewed literature. Given the current interest in this general subject area by the US Department of Energy, the US Department of Transportation, state and local government, and the private sector this bibliography should be viewed as a dynamic document to which additional references will be added as they are identified and reviewed. Although the list of reference included in this bibliography is extensive, from the viewpoint of providing specific guidance for the identification of flood hazard zones and the design of drainage protection for a potential rail line across an alluvial fan there is very little information. Numerous publications of the Federal Highway Administration and the transportation departments of the southwestern states were reviewed. Alluvial fan crossings receive only minimal attention in these publications. 171 refs.

64 PHYSICS I

Refer also to citation(s) 12872

6401 Astrophysics and Cosmology

Refer also to citation(s) 13619

13590 (ANL-HEP-CP–90-106) **Signals from cosmic ray sources, some statistical issues.** Goodman, M. Argonne National Lab., IL (USA). 27 Oct 1990. 5p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-9006267–25: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91008727. Source: OSTI; NTIS; INIS; GPO Dep.

The possible existence of discrete sources of cosmic rays is presently one of the main topics of study in non-accelerator particle physics. The search is being conducted in a wide variety of experiments using UHE-γ rays, VHE-γ rays, EeV particles, underground μ's and ν's. The current experimental situation, however, can be described as chaotic. The number of claimed observations of sources by different groups using a variety of experimental techniques is quite large, but a consistent interpretation of the various results has failed to emerge. Most of the observations rely on either on "dc excess" from the direction of the source, a periodicity of the events from that direction, or some combination of these two effects. In the first section of this paper, we discuss some of the techniques that may be used in searching for a dc excess. We review two common bin free tests of the light curves. We discuss a particular problem involving phase coherence when doing a period search. This paper discusses some of the issues and meanings involved in combining probabilities from more than one test. Prescribing the "right" way to do analysis is certainly beyond this paper's scope. However some of the issues and problems are considered here.

13591 (BNL–45580) **Imaging performance and tests of soft x-ray telescopes.** Spiller, E. (International Business Machines Corp., Yorktown Heights, NY (USA). Thomas J. Watson Research Center); McCorkle, R.; Wilczynski, J.; Golub, L.; Nystrom, G.; Takacz, P.Z.; Welch, C. Brookhaven National Lab., Upton, NY (USA). Aug 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-900756–58: 34. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE91007557. Source: OSTI; NTIS; GPO Dep.

Photos obtained during 5 min. of observation time from the flight of our 10 in. normal incidence soft x-ray (λ = 63.5Å) telescope on September 11, 1989 are analyzed and the data are compared to the results expected from tests of the mirror surfaces. These tests cover a range of spatial periods from 25 cm to 1Å. The photos demonstrate a reduction in the scattering of the multilayer mirror compared to a single surface for scattering angles above 1 arcmin, corresponding to surface irregularities with spatial periods below 10 μm. Our results are used to predict the possible performance of future flights. Sounding rocket observations might be able to reach a resolution around 0.1 arcsec. Higher resolutions will require flights of longer durations and improvements in mirror testing for the largest spatial periods. 21 refs., 7 figs., 1 tab.

13592 (CONF-9003115–) **Proceedings of the 17th annual day of scientific lectures and 13th annual meeting of the National Society of Black Physicists.** Reed, K.J. (ed.). Lawrence Livermore National Lab., CA (USA). [1990]. 243p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract W-7405-ENG-48. From 17. annual day of scientific lectures and 13. annual meeting of the National Society of Black Physicists; Baton Rouge, LA (USA); 21-24 Mar 1990. Order Number DE91009432. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains paper on the following topics: Evaporating Black Holes in an Inflationary Universe; Completely and Partially Polarized Signal Propagation; Is the Jet in Quasar 1038 + 064 Precessing? Physics of the Anisotropic Ferrite Wakefield Accelerator;

Absolute Multilayer Characterization at High Spatial Resolution via Real Time Soft X-Ray Imaging; Update on the Status of the Superconducting Supercollider (SSC) Laboratory: The Use of Charge Coupled Devices in Remote Sensing from Space; A Scientific Visit to the USSR; Migdal-Kadanoff Study of Z_5 Symmetric Systems with Generalized Action – Part 1; Migdal-Kadanoff Study of Z_5 Symmetric Systems with Generalized Action – Part 2; and The Voyager Mission Exploration of the Solar System with Robotic Spacecraft.

13593 (DOE/ER/13670–2) **Solar variability observed through changes in solar figure and mean diameter: Progress report, June 1, 1990–May 31, 1991.** Hill, H.A. Arizona Univ., Tucson, AZ (USA). Dept. of Physics. 25 Jan 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER13670. Order Number DE91009813. Source: OSTI; NTIS; INIS; GPO Dep.

The work performed on solar variability during 1990 at SCLERA is reviewed. That portion of the SCLERA research program supported by the Department of Energy has been directed toward the detection and monitoring of climatically significant solar variability by accurate measurement of the variability in solar shape and diameter. Observations were obtained in 1990 and results from analysis of earlier observations obtained. The observational evidence of systematic long-term changes in the apparent solar diameter and/or radius has been detected, and these changes continue to strongly correlated with long-term changes in solar total irradiance. Additional evidence for internal gravity modes has been found which may be important to understanding the internal structure of the Sun. Each of these findings shows promise for anticipating future changes in the solar luminosity. Progress has been made in setting up an international network based on SCLERA-type instruments to improve the coverage and quality of the observations. A proposal is made for the continuation of support from the Department of Energy for further studies relevant to solar-variability forecasting.

13594 (FNAL/C–91/51-A) **Natural inflation.** Frieman, J.A. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-901141–2: International conference on trends in astroparticle physics, Santa Monica, CA (USA), 26 Nov - 1 dec 1990). Order Number DE91009459. Source: OSTI; NTIS; GPO Dep.

A pseduo-Nambu-Goldstone boson, with a potential of the form $V(\phi) = \Lambda^4[1 \pm \cos(\phi/f)]$, can naturally give rise to an epoch of inflation in the early universe. Successful inflation can be achieved if $f \sim m_{pl}$ and $\Lambda \sim m_{GUT}$. Such mass scales arise in particle physics models with a gauge group that becomes strongly interacting a the GUT scale, e.g., as is expected to happen in the hidden sector of superstring theories. The density fluctuation spectrum is a non-scale-invariant power law, with extra power on large scales. 12 refs., 3 figs.

13595 (FNAL/C–91/53-A) **Can non-Gaussian fluctuations for structure formation arise from inflation?.** Salopek, D.S. Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract AC02-76CH03000. Grant NAGW-1340. (CONF-901282–1: NATO advanced research workshop: Observational tests of inflation, Durham (UK), 10-14 Dec 1990). Order Number DE91009458. Source: OSTI; NTIS; GPO Dep.

Non-Guassian fluctuation for structure formation may be generated during the inflationary epoch from the nonlinear interaction of two scalar fields with gravity. Semi-analytical calculations are given describing nonlinear long wavelength evolution in 3 + 1 dimensions. Long wavelength fields are governed by a single equation, the separated Hamilton-Jacobi equation (SHJE). I discuss complete analytic solutions of the SHJE for two scalar fields with a potential whose logarithm 1n V (ϕ_i) is linear. More complicated potential surfaces may be approximated by continuously joining various linear 1n V(ϕ_i) potentials. Typically, non-Gaussian fluctuations arise when one passes over several sharp ridges in the potential surface. One can input this richer class of initial conditions into N-body codes to see the effects on the large scale structure in the Universe. The cleanest test of non-Gaussian fluctuations will hopefully occur in the near future from large angle microwave background anisotropy experiments. 13 refs., 3 figs.

13596 (FNAL/C–91/61-A) **Indirect detection of heavy supersymmetric dark matter.** Kamionkowski, M. (Chicago Univ., IL (USA)). Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 5p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract AC02-76CH03000. Grant NGW-1340. (CONF-901141–3: International conference on trends in astroparticle physics, Santa Monica, CA (USA), 26 Nov - 1 dec 1990). Order Number DE91009669. Source: OSTI; NTIS; INIS; GPO Dep.

If neutralinos reside in the galactic halo they will be captured in the Sun and annihilate therein producing high-energy neutrinos. Present limits on the flux of such neutrinos from underground detectors such as IMB and Kamiokande 2 may be used to rule out certain supersymmetric dark-matter candidates, while in many other supersymmetric models the rates are large enough that if neutralinos do reside in the galactic halo, observation of a neutrino signal may be possible in the near future. 10 refs., 2 figs.

13597 (GSI–90-68(prepr.)) **Search for supermassive nuclei in nature.** Polikanov, S. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Sastri, C.S.; Herrmann, G.; Luetzenkirchen, K.; Overbeck, M.; Trautmann, N.; Breskin, A.; Chechik, R.; Fraenkel, Z. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Nov 1990. 21p. Order Number DE91756666. Source: OSTI; NTIS (US Sales Only); INIS.

We report on a search for supermassive nuclei in nature with masses up to 10^7 amu. Such exotic nuclei might consist, for example, of stable strange matter, which comprises a mixture of up, down, and strange quarks, or of relic particles from the early Universe. The experiments are based on Rutherford backscattering of heavy ions, preferably ^{238}U, from various target samples. The measured parameters of a deteced particle are its time-of-flight, scattering angle, and specific ionization. From this information the mass of the target nucleus can be inferred. Upper limits for the abundance of strange supermassive nuclei with masses $A \simeq 4x10^2$ to 10^7 amu relative to the number of nucleons were found to be in the range 10^{-11} to 10^{-15}. For the narrower mass range $A \simeq 10^3$ to 10^4 amu the limit is $2x10^{-17}$. (orig.).

13598 (KFKI–1990-27/C) **On the existence of a mantle region in the magnetosphere of nonmagnetic solar system bodies.** Szego, K. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Sagdeev, R.Z.; Shapiro, V.D.; Shevchenko, V.I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. [1990]. 17p. (CONF-9006220–6: 28. COSPAR plenary conference, The Hague (Netherlands), 25 Jun - 6 jul 1990). Order Number DE91009149. Source: OSTI; NTIS (US Sales Only).

In this paper we examine the question how turbulent wave particle processes modify on dayside the MHD obstacle boundary for non magnetic bodies which posses atmosphere. Inside the magnetosphere of nonmagnetic bodies, there is always a central part, a magnetic cavity where the solar wind magnetic field normally can not penetrate. The Ionosphere of the body, residing inside this cavity, can penetrate through the cavity boundary, forming a region populated by planetary/cometary ions and shocked solar wind. This region is called mantle. As experimental evidences show it exists around Mars, Venus and comets. In the mantle the cold planetary ion form a beam in the decelerated solar wind, exciting waves in the low hybrid frequency region. The waves accelerate the electrons, and also transmit momenta to the cold heavy ion, resulting in a friction like interaction between the solar wind and planetary ions. It is likely that the diffusive processes in the mantle defines the most important physical characteristics of this region. 29 refs., 11 figs.

13599 (LA-UR–91-618) **Proton induced x-ray emission (PIXE) micro-analysis of Apollo 15 green glass: Preliminary experiments.** Shearer, C.K. (New Mexico Univ., Albuquerque, NM (USA). Inst. of Meteoritics); Papike, J.J.; Hickmott, D.D.; Rogers, S.Z. Los Alamos National Lab., NM (USA). [1991]. 3p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9103134–1: Lunar and planetary science conference, Houston, TX (USA), 18-22 Mar 1991). Order Number DE91008596. Source: OSTI; NTIS; GPO Dep.

Short communication. LUNAR MATERIALS/x-ray emission analysis; GLASS; APOLLO PROJECT; ENERGY SPECTRA

13600 (UCRL-JC–105999) **Line and continuum spectroscopy as diagnostic tools for gamma ray bursts.** Liang, E.P. Lawrence Livermore National Lab., CA (USA). Dec 1990. 17p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901275–1: Gamma-ray line astrophysics symposium, Paris (France), 10-13 Dec 1990). Order Number DE91008062. Source: OSTI; NTIS; INIS; GPO Dep.

We review the theoretical framework of both line and continuum spectra formation in gamma ray bursts. These include the cyclotron features at 10's of keV, redshifted annihilation features at ~400 keV, as well as other potentially detectable nuclear transition lines, atomic x-ray lines, proton cyclotron lines and plasma oscillation lines. By combining the parameters derived from line and continuum modeling we can try to reconstruct the location, geometry and physical conditions of the burst emission region, thereby constraining and discriminating the astrophysical models. Hence spectroscopy with current and future generations of detectors should provide powerful diagnostic tools for gamma ray bursters. 48 refs., 10 figs., 4 tabs.

6402 Atmospheric Physics

13601 (UCRL-JC–106422) **Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code.** Matsuda, Y. Lawrence Livermore National Lab., CA (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9104109–2: 4. international school for space simulation, Nara (Japan), 1-5 Apr 1991). Order Number DE91009736. Source: OSTI; NTIS; INIS; GPO Dep.

An intense terrestrial radiation called the auroral kilometric radiation (AKR) is believed to be generated by cyclotron maser instability. We study a quasilinear evolution of this instability by means of a two-dimensional relativistic Fokker-Planck code which treats waves and distributions self-consistently, including radiation loss and electron source and sink. We compare the distributions and wave amplitude with spacecraft observations to elucidate physical processes involved. 3 refs., 1 fig.

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 13041, 13128, 13148, 13246, 13700, 13758, 13761, 13828, 13860, 13861, 13883

13602 (CONF-9006242–4) **Electron emission from a ferroelectric surface: A new generation of pulsed electron beam sources.** Gundel, H. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Theoretische Elektrotechnik. [1990]. 16p. From Workshop on short pulse high current cathodes; Bendor (France); 18-22 Jun 1990. Order Number DE91009151. Source: OSTI; NTIS (US Sales Only).

This report discusses experimental approaches of producing pulsed electron beams rising ferroelectric materials. (LSP)

13603 (CRIE-W–89052) **Survey on electron beam processing technologies.** Yasui, S. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)); Sunabe, K.; Inaba, T. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jun 1990. 35p. (In Japanese). Order Number DE91759126. Source: OSTI; NTIS (US Sales Only).

This paper investigated the developing situation of electron beam processing technologies and showed the future problems when these are utilized for electric power utilities. When an electron beam is used as a heating source by focussing, the electron beam has features of high focusability, high controllability and high energy density, so that the electron beam is used for parts requiring high quality processing from micro machining, case hardening, welding to melting furnaces of metals of high melting point. It is necessary in the present level of technology to hold ultra high boltage for acceleration and high vacuum because of lower current. Since the processing capability with high energy density is high and the enegy utilizing efficiency is also high for the chemical field using the high energy density of the electron beam, the application is researched in the wide field from sterilization of medical instruments, sterilization of sludge, through food processing, improvement of thermal resistance of insulated wires to flue gas irradiation to desulfurize and denitrify. But the practical use is not yet realized because of small current of electron beam. Therefore, the largest technological problem may be the development of high current electron gun and the beam control systems. 36 refs., 10 figs., 11 tabs.

13604 (DOE/ER/13456–24) **The production and destruction of negative ions: Progress report, September 1, 1989–August 31, 1990.** Pegg, D.J. Tennessee Univ., Knoxville, TN (USA). Dept. of Physics. [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-85ER13456. Order Number DE91009518. Source: OSTI; NTIS; INIS; GPO Dep.

During the present grant period we have continued our study of the photodetachment of atomic negative ions using cross-beam photoelectron detachment spectroscopy. The experimental technique involves the measurement of, under conditions of good energy and angular resolution, kinetic energies, yields and angular distributions of photoelectrons ejected from the interaction region between perpendicularly crossed laser and negative ion beams. 6 figs.

13605 (DOE/ER/13456–31) **The production and destruction of negative ions: Progress report, September 1, 1990–August 31, 1991.** Pegg, D.J. Tennessee Univ., Knoxville, TN (USA). Dept. of Physics. [1991]. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-85ER13456. Order Number DE91009517. Source: OSTI; NTIS; INIS; GPO Dep.

During the present grant period we are continuing our measurements of cross sections and asymmetry parameters for single photon-single electron detachment from atomic negative ions. In this period we have studied the stable ions B^- and Li^-. As a by product of these measurements we have investigated a new technique for measuring electron affinities. As in our previous work, we have made energy- and angle-resolved spectroscopic measurements of the yields and angular distributions of photoelectrons ejected at the intersection of perpendicularly crossed laser and negative ion beams. A combination of measurements of photoelectron yields, which are proportional to differential cross sections, and angular distributions allow us to determine angle-integrated cross sections for the photodetachment process. Cross sections for the inverse process of radiative attachment can be obtained from the photodetachment data by applying the principle of detailed balance.

13606 (DOE/ER/13971–7) **Measurements of scattering processes in negative ion-atom collisions: Progress report, 1 September 1988–31 August 1991.** Kvale, T.J. Toledo Univ., OH (USA). Dept. of Physics and Astronomy. 27 Feb 1991. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER13971. Order Number DE91009514. Source: OSTI; NTIS; INIS; GPO Dep.

This research project is designed to provide measurements of various scattering processes which occur in H^- collisions with atomic targets at intermediate energies. The immediate goal is to study elastic scattering, single electron detachment, and target excitation/ionization in H^- scattering from noble gas targets. For the target inelastic processes, these cross sections are unknown both experimentally and theoretically. The present measurements will provide either experimentally-determined cross sections or set upper limits to those cross sections. In either case, these measurements will be stringent tests of our understanding in energetic negative ion collisions. This series of experiments required the construction of a new facility, and significant progress toward its operation has been realized during this period. The proposed research is described in this report. The progress on and the status of the apparatus is also detailed in this report.

13607 (DOE/ER/40224–183) **Apparatus and method for improving radiation coherence and reducing beam emittance.** Csonka, P.L. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. [1991]. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. Order Number DE91009569. Source: OSTI; NTIS; INIS; GPO Dep.

A partially coherent beam-shaped pulse of particles (referred to in the following as x-rays) is sectioned longitudinally into numerous beam-shaped pulses of smaller cross section. The diameter of these smaller beams more closely approaches the transverse coherence length desired in a particular experiment. The various beams are guided along separate paths which have different lengths in order to delay each pulse by a different period of time. The delayed pulses are then directed toward a rotating mirror which deflects them all along the same path, one after another. In this manner, a relatively wide and short beam-shaped pulse with poor transverse coherence is converted into a long, narrow pulse with good transverse coherence.

13608 (INS-T–498, pp. 104-106) **Subthreshold π production.** Ishida, Katsuhiko (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. PION DETECTION/threshold energy; PION PLUS REACTIONS; MUON DETECTION; MUONS PLUS; MUONS MINUS; HEAVY ION REACTIONS; NITROGEN 14 REACTIONS; TARGETS; NUCLEAR REACTIONS

13609 (LRP–424/90) **Atoms in strong electromagnetic fields.** Oberman, C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1990. 58p. Order Number DE91622984. Source: OSTI; NTIS (US Sales Only); INIS.

It is reported on some fundamental calculations of atomic physics necessitated by having to take into account the fact that some current laser field strenghts in the focal region are comparable to or even greater than atomic fields. The time-honored technique of perturbation theory becomes prohibitively difficult and for sufficiently large intensities inadequate, and new techniques must be found to describe the laser-plasma interaction. Transitions involving the absorption or emission of many field quanta can occur under these circumstances. Since the laser frequency ω is in general much less than atomic frequencies we are able to remain within the classical description of the electromagnetic field and are led to develop a description asymptotic in ω/Δ where $\Delta \equiv (E_2 - E_1)/2$ and E_1 and E_2 are two characteristic atomic frequencies. Comments on three pieces of work are given: on multiphoton excitation with a simple atomic model, on multiphoton ionization again within a simple mode, and finally on a treatment of multiphoton ionization of a complex high Z atom in which is argued for a modified Thomas-Fermi description. figs., 15 refs.

13610 (PPPL–2735) **Quenching of Einstein-coefficients by photons.** Aumayr, F. (Technische Univ., Vienna (Austria). Inst. fuer Allgemeine Physik); Lee, W.; Skinner, C.H.; Suckewer, S. Princeton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91010011. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental evidence is presented for the change of Einstein's A- coefficients for spontaneous transitions from the upper laser level of argon ion laser discharge due to the presence of the high-intensity laser flux. To demonstrate that this quenching effect cannot be attributed to a reduction in self-absorption of the strong spontaneous emission line, absorption and line profile measurements have been performed. Computer modelling of the reduction of self absorption due to Rabi splitting also indicated that this effect is too small to explain the observed quenching of spontaneous line emissions. 13 refs., 11 figs.

13611 (UCRL-CR–104696) **Survey of alternative laser sources for Backscatter Absorption Gas Imaging (BAGI).** Kulp, T.J. Lawrence Livermore National Lab., CA (USA). Jan 1991. 71p. Sponsored by U.S. DOE Contract W-7405-ENG-48. Order Number DE91008444. Source: OSTI; NTIS; GPO Dep.

This report is the result of a Backscatter Absorption Gas Imaging (BAGI) development task in which the feasibility of imaging five gaseous species was to be evaluated. The five gases to be evaluated are carbon monoxide, carbon dioxide, hydrogen, hydrogen sulfide, and Halon. Because it is clear that some of these gases cannot be detected with the current BAGI system (based on the 9 to 11 μm carbon dioxide laser), it was decided that the feasibility of using BAGI at other wavelengths would be evaluated. This report summarizes the results of that study, and provides some comments on the feasibility of imaging the five gases. It is not intended to be a comprehensive compilation of all possible laser sources that can be used with BAGI, but rather a survey of some alternate configurations that might allow other gases/spectral regions to be covered. The scope of the survey will be limited to imaging systems of the same design as the present BAGI device; i.e., imagers that detect the absorption of backscattered laser radiation using x-y scanning optics in conjunction with a continuous-wave (CW) laser beam. It is conceivable that other types of laser-based gas-imaging devices may be feasible, as well. These might include sensors based on focal-plane detector arrays (using either CW or pulsed-laser sources) and sensors that use other spectral signals to visualize a plume. We will leave the evaluation of those possibilities for later work.

6404 Fluid Physics

Refer also to citation(s) 13914

13612 (DOE/ER/13597–T3) **Experimental and theoretical studies of vertical annular liquid jets: Final technical report.** Ramos, J.I. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering. 24 Feb 1990. 77p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract FG02-86ER13597. Order Number DE91008042. Source: OSTI; NTIS; GPO Dep.

This report describes theoretical studies on vertical annular jets, determines the conditions under which vertical jets form an enclosed volume which can be used as a chemical reactor, assesses the influence of the nozzle gap width, nozzle geometry, pressure difference across the annular jet, and Froude, Weber and Reynolds numbers on the annular jet's covergence length, and determines the mass absorption rate by the liquid jet as a function of the aforementioned parameters and Peclet number. Both analytical and numerical solutions of the governing equations are presented, and the ranges of the parameters for which the analytical solutions are valid are determined. In addition, the numerical solution of the governing equations are compared with experimental data, and the response of the liquid curtain to fluctuations in the mass flow rate at the nozzle exit, injection pressure in the volume enclosed by the annular jet, and pressure fluctuations, is determined numerically. The collapse of annular jets due to mass absorption is also determined as a function of the Froude, Weber and Peclet numbers, solubilities of the gas in the liquid, pressure and nozzle geometry. Analytical and numerical studies on annular jets in zero-gravity, and a theory of liquid membranes are also discussed. 57 refs., 19 figs.

13613 (DOE/ER/25061–9) **General three-dimensional disturbances to inviscid Couette flow.** Criminale, W.O.; Long, B.; Zhu, Mei. Washington Univ., Seattle, WA (USA). Dept. of Applied Mathematics. Dec 1990. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-88ER25061. (TR–90-9). Order Number DE91009593. Source: OSTI; NTIS; GPO Dep.

The general solution to the linearized equations governing three-dimensional disturbances to inviscid Couette flow has been obtained. This result extends the Orr solution to initial conditions that do not consist of a single Fourier sine component in the cross-stream coordinate and a plane wave in the streamwise/spanwise coordinates. The time evolution of a measure of disturbance energy for some specific pulsed initial conditions is examined, and is concluded that, while the rapid algebraic growth to large amplitude followed by decay exemplified by the Orr solution can be of importance for individual cross-stream Fourier components, more realistic initial conditions which in general consist of the sum of an infinite number of components often display uniform decay to zero amplitude. However, an interesting example is described in which one positive definite measure of disturbance amplitude remains constant, yet the stream-wise/spanwise velocity components grow

linearly in time if the initial disturbance is three-dimensional. 7 refs., 12 figs.

13614 (ENEA-RT-INN–90-01) **Gaseous separation membranes.** Fabiani, C.; Terghil, R. ENEA, Casaccia (Italy). Area Energia e Innovazione. Oct 1990. 100p. (In Italian). (RT/INN–90-01). Order Number DE91752921. Source: OSTI; NTIS (US Sales Only); INIS.

A review of the most commonly used transport model for gas permeation through non-porous polymeric membranes is presented. The main methods and apparatus for the experimental measurements of solubility, diffusivity and permeability are critically discussed. The appendix collects an extensive selection of transport data for the most important gases and polymeric membranes.

13615 (LA-UR–91-589) **Layer tracking asymptotics and domain decomposition.** Brown, D.L. (Los Alamos National Lab., NM (USA)); Chin, R.C.Y.; Hedstrom, G.W.; Manteuffel, T.A. Los Alamos National Lab., NM (USA). [1990]. 18p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36 ;W-7405-ENG-48. (CONF-9009351–1: ICASE workshop: heterogeneous boundary condition, Hampton, VA (USA), 26-28 Sep 1990). Order Number DE91008593. Source: OSTI; NTIS; GPO Dep.

In this paper we present a preliminary report on our work on the tracking of internal layers in a singularly-perturbed convection-diffusion equation. We show why such tracking may be desirable, and we also show how to do it using domain decomposition based on asymptotic analysis. 16 refs.

13616 (SAND–90-2656C) **3-D turbulent flows past submarine models: Numerical simulation collated with experimental data.** Givler, R.C. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9104202–1: 4. FIDAP users conference, Evanston, IL (USA), 14-16 Apr 1991). Order Number DE91009473. Source: OSTI; NTIS; GPO Dep.

Large-scale numerical simulations of turbulent flow past bare and appended submarine hulls have been completed with FIDAP versions 4.5 and 5.0. A standard k-ϵ turbulence model was employed to resolve the near-body flow field for all numerical calculations. Results from these simulations (profile plots and wake surveys of velocity, pressure and turbulent kinetic energy – hull pressures and shear stresses – total drag) are compared with data from dynamically similar experiments. The Reynolds number, based upon model length, for both simulation and experiment was 1.2×10^7. Agreement between untuned numerical predictions and experimental data is remarkably close for several model geometries. In other cases, quantitative differences are attributed to the choice of turbulence model and the numerical implementation of boundary conditions. 3 refs., 16 figs.

13617 (UCRL-ID–105872) **Plane Stokes flow driven by capillarity on the free surfaces of a doubly-connected region.** Hopper, R.W. Lawrence Livermore National Lab., CA (USA). 7 Jan 1991. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008627. Source: OSTI; NTIS; GPO Dep.

The free creeping viscous incompressible plant flow a finite region, bounded by a simple smooth closed curve and driven solely by surface tension, was analyzed previously. The shape evolution was described in terms of a time-dependent mapping function $z = \Omega(\zeta,t)$ of the unit circle, conformal on $|\zeta| \leq 1$. An equation giving the time evolution of the mapping, typically in parametric form, was derived. The theory is here extended to doubly-connected regions mapped from an annulus. It is found that the conjectured parametric map must satisfy three conditions. The elementary problem of the collapse of a concentric circular annulus is easily recovered, but no non-trivial flows have been discovered. The theory is used to show that confocal elliptic ring does not collapse through a sequence of confocal elliptic rings. 5 refs., 1 fig.

6450 High Energy Physics

Refer also to citation(s) 13592, 13882

13618 (DOE/ER/40224–133) **[Theory of elementary particles studies in weak interation and grand unification and studies in accelerator design]: Annual report, Task A.** Oregon Univ., Eugene, OR (USA). [1990]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. Order Number DE91009589. Source: OSTI; NTIS; INIS; GPO Dep.

The topics discussed in this report are rare B decays; left-right symmetry; rare z decays; studies in string compactification; jet cross section; semi-inclusive deeply inelastic scattering; effective approximation; multifractal analysis; quark-gluon plasma; and geometrical branching model. (LSP)

13619 (DOE/ER/40235–T6) **[Theoretical studies in elementary particle physics]: Final technical progress report, 1980–1990.** Collins, J. Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Physics. [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85ER40235. Order Number DE91009543. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: Factorization for hard processes in QCD; Sudakov form factors and transverse momentum distributions; Semi-hard processes; otter QCD issues; Cosmic rays from point sources; Higgs and other collider phenomenology; and cosmology. (LSP)

13620 (LBL–29470) **Symmetries on the space of (2,2) superstring vacua and automorphism groups of Calabi-Yau manifolds.** Giveon, A.; Smit, D.J. Lawrence Berkeley Lab., CA (USA). Aug 1990. 35p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9005316–1: International seminar on common threads in mathematics and quantum field theory, Kyoto (Japan), 10-22 May 1990; UCB-PTH–90/37). Order Number DE91008218. Source: OSTI; NTIS; GPO Dep.

Symmetry groups on the space of (2,2) string vacua for c = 3,6,9 are discussed in the context of orbifoldized Landau-Ginzburg theories. A general method for finding the maximal symmetry groups on the moduli space of untwisted marginal operators is presented, by studying symmetries on the resolution of isolated singularities of superpotentials. Stabilizing subgroups of such symmetry groups are shown to correspond with automorphism groups of Calabi-Yau manifolds. In addition to our earlier work on this subject we present some new examples for c = 9 (2,2) vacua. Susbsequently we discuss modular transformations that relate small volume target-spaces to large ones. 54 refs., 3 tabs.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 13280, 13317, 13320, 13739

13621 (BNL–45828) **Experiments at future hadron colliders.** Paige, F.E. Brookhaven National Lab., Upton, NY (USA). Jan 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9006267–28: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91009468. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes signatures and backgrounds for processes in high-energy hadronic collisions, particularly at the SSC. It includes both signatures for new particles – t quarks, Higgs bosons, new Z′ bosons, supersymmetric particles, and technicolor particles – and other experiments which might be done. It is based on the 1990 Snowmass Workshop and on work contained in the Expressions of Interest submitted to the SSC. 46 refs., 19 figs., 1 tab.

13622 (BNL–45842) **Can RHIC be used to test QED?.** Fatyga, M.; Rhoades-Brown, M.; Tannenbaum, M. Brookhaven National Lab., Upton, NY (USA). [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9004261–Summ.: Workshop on can RHIC be used to test QED, Upton, NY (USA), 20-21 Apr 1990). Order Number DE91009433. Source: OSTI; NTIS; INIS; GPO Dep.

Three general subjects were addressed during the workshop. These subjects were: to understand the validity of the best available descriptions of $e^+ e^-$ pair production in peripheral heavy ion collisions, especially for the domain where this process is known to

be non-perturbative. To understand the prospects for using relativistic heavy ions to produce Higgs Bosons or Weak bosons (Z_0, W+, W−). This production mechanism proceeds through the virtual two photon representation of the heavy ions, and is considered a reason for accelerating heavy ions in both the LHC and the SSC. To study the interference mechanisms between the two processes for hadron production in peripheral heavy ion collisions. These two processes are two photon exchange and two pomeron exchange.

13623 (BNL–45843) **Search for the U(3.1)–$\bar{\Lambda}p\pi$'s from $\bar{p}p$ interactions at 8 GeV/c.** Boehnlein, A. (Florida State Univ., Tallahassee, FL (USA)); Boehnlein, D.; Goldman, J.H.; Hagopian, V.; Chung, S.U.; Fernow, R.; Kirk, H.; Protopopescu, S.D.; Willutzki, H.J.; Blessing, S.; Crittenden, R.; Dzierba, A.; Zieminska, D.; Bonner, B.; Clement, JBrookhaven National Lab., Upton, NY (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC02-76CH00016 ;FG05-87ER40319 ;AC02-84ER40125. Grant PHY90-01349. (CONF-9009309–12: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91009449. Source: OSTI; NTIS; INIS; GPO Dep.

A search for the U(3.1) resonance decaying into $\bar{\Lambda}p\pi$'s final states has been performed with negative results. The cross section upper limits are between 10 and 25 nanobarns. These cross sections are one or two order of magnitude lower than expected from previous results. Mass spectra of various final states are presented. 7 refs., 4 figs., 1 tab.

13624 (BNL–45845) **Search for exotic states, BNL experiments E818 and E852.** Dowd, J. (Southeastern Massachusetts Univ., North Dartmouth, MA (USA)). Brookhaven National Lab., Upton, NY (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9009309–10: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91009451. Source: OSTI; NTIS; INIS; GPO Dep.

We have performed an experiment (E-818) to search for exotic states in the reaction $\pi^-p \rightarrow X^-p$ at 18 GeV/c at the Brookhaven MPS-2. The X^- was detected through the sequential decay $X^- \rightarrow f_1(1285)\pi^-$; $f_1(1285) \rightarrow K^+K^0_s\pi^-$. In the flux tube model such final states are expected from the decay of explicitly exotic $J^{PC} = 1^{\mp}$ hybrid mesons. We present preliminary results of this experiment and estimates of the expected sensitivity to hybrid states. We also describe the status of a new equipment (E-852) to search for exotic mesons in both neutral and charged final states in the reactions $\pi^-p \rightarrow M^0n$ and $\pi^-p \rightarrow M^-p$ at 21 GeV/c where M is a meson decaying into photons and 0, 1 or 2 charged particles. 4 refs., 9 figs., 1 tabs.

13625 (BNL–45846) **Hadron spectroscopy at RHIC and KAON.** Chung, S.U. Brookhaven National Lab., Upton, NY (USA). [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9009309–9: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91009469. Source: OSTI; NTIS; INIS; GPO Dep.

A description is given of the physics opportunities at RHIC regarding quark-gluon spectroscopy. The basic idea is to isolate with appropriate triggers the sub-processes pomeron + pomeron → hadrons and $\gamma^*+\gamma^* \rightarrow$ hadrons with the net effective mass of hadrons in the range of 1.0 to 10.0 GeV, in order to study the hadronic states composed of u, d, c, b and gluons. The double-pomeron interactions are expected to produce glueballs and hybrids preferentially, while the two-offshell-photon initial states should couple predominantly to quarkonia and multiquark states. Of particular interest is the possibility of carrying out a CP-violation study in the B decays. The KAON facility, proposed for TRIUMF, Vancouver, Canada, is an intense hadron factory with a proton flux some 25 times higher than that available at the BNL AGS with the Booster. Therefore, a general purpose hadron spectrometer will be able to tackle the problem of studying gluonic and multiquark degrees of freedom in strangeonia. 19 refs., 3 figs.

13626 (BNL–45847) **Preliminary partial-wave analysis of the $K^+K^0_s\pi^-$ system produced in 8 GeV/c K^-p interactions.** King, E. (Southeastern Massachusetts Univ., North Dartmouth, MA (USA)); Bar-Yam, Z.; Dowd, J.; Kern, W.; Rulon, P. III; Blessing, S.K.; Crittenden, R.R.; Dzierba, A.R.; Marshall, T.; Teige, S.W.; Zieminska, D.; Boehnlein, A.; Boehnlein, D.; Goldman, J.H.;.Brookhaven National Lab., Upton, NY (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9009309–8: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91009452. Source: OSTI; NTIS; INIS; GPO Dep.

We have performed a partial-wave analysis of the $K^+K^0_s\pi-$ system produced in the reaction $K^-p \rightarrow K^+K^0_s\pi^- \Lambda/\Sigma$ at 8 GeV/c. We present results of a preliminary analysis of approximately 2000 events in the $K^-K\pi$ mass range 1.24–1.64 GeV, with $0.0 < -t < 1.4$ GeV^2. In the 1.28 GeV mass region, we observe a small $J^{PG} = 0^{\mp}$ contribution but little indication of a 1^{++} wave. We observe a large enhancement of events at the threshold of KK* production. Above this threshold the $J^{PG} = 1^{\pm}$, 1^{++} and $0^{\mp}$ waves all contribute, and we see evidence for a $1^{\pm}$ resonance below the KK* threshold. 7 refs., 9 figs., 1 tab.

13627 (DESY-F31–90-01) **Measurement of total hadronic cross section $\sigma(e^+e^- \rightarrow$hadrons) in the continuum at the c.m. energy W=9.39 GeV and determination of Γ_{ee} of the Υ(1S) and Υ(2S) resonances.** Jakubowski, Z. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Institute of Nuclear Physics, Cracow (Poland). Jan 1990. 101p. Order Number DE91756670. Source: OSTI; NTIS (US Sales Only); INIS.

This work is based on a study of e^+e^- collisions in the energy region of Υ(1S) and Υ(2S) resonances. Using the data taken by the Crystal Ball Detector in the continuum below Υ(1S) we have determined the value of R, the ratio of the hadronic cross section to the Born cross section of μ pair production, at c.m. energy W = 9.39 GeV to be $R = 3.48\pm0.04\pm0.14$. This is the most precise measurement of R below the Υ(1S) threshold. Resonance scan data were used to determine the leptonic partial widths Γ_{ee} of Υ(1S) and Υ(2S). We find $\Gamma_{ee}(\Upsilon(1S))=(1.34\pm0.03\pm0.06)$ keV, $\Gamma_{ee}(\Upsilon(2S))=(0.56\pm0.03\pm0.02)$ keV. The method of obtaining Γ_{ee} from the measured excitation curve is not unique. Our results are $\propto$10% higher than those already published mainly because we used an internally consistent treatment of the radiative corrections. We discuss the effect of applying different theoretical prescriptions for the radiative corrections on Γ_{ee}. Both results presented here require the knowledge of the absolute cross sections to a high precision. Uncertainties in the corrections to the cross section due to detector efficiency constitute the main source of the systematic error. To minimize these uncertainties substantial modifications of the detector simulation program GHEISHA were necessary to obtain a satisfactory description of the data. The modifications may be of importance for other calorimetric experiments. (orig.).

13628 (DOE/ER/40224–179) **The Z^0 resonance in e^+e^- annihilation.** Frey, R. Oregon Univ., Eugene, OR (USA). Dept. of Physics. [1989]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (CONF-8906267–6: TASI '89: Theoretical Advanced Summer Institute in elementary particle physics, Boulder, CO (USA), 4-30 Jun 1989). Order Number DE91009506. Source: OSTI; NTIS; INIS; GPO Dep.

The Z^0 resonance parameters have been measured by the Mark II experiment at the SLC. The most significant new result excludes a fourth-generation species of light neutrino at 95% confidence level. The methods and results are discussed. 10 refs., 3 figs., 1 tab.

13629 (DOE/ER/40457–T1) **[Hadroproduction of bottom using the 800 GeV/c primary proton beam at the Fermilab tevatron]: High energy physics status report.** Judd, D.J. Prairie View A and M Univ., TX (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS05-88ER40457. Order Number DE91009541. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research for support of hadroproduction of charmonium and high P_t direct photons using the 800 GeV/c primary proton beam at the Fermilab Trevatron. (LSP)

13630 (FNAL/C–90/271-E) **Energy flow and transverse momentum of hadron jets produced in deep inelastic muon scattering.** Lubatti, H.J. (Washington Univ., Seattle, WA (USA).

Dept. of Physics). The E-665 Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). Dec 1990. 6p. Sponsored by USDOE,. DOE Contract AC02-76CH03000. (CONF-900822–30: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE91008616. Source: OSTI; NTIS; INIS; GPO Dep.

Forward di-jet production observed in μp and μd interactions (Fermilab E665) is reported. The W^2 range studied, $100 < W^2 < 900\ GeV^2$, is the largest yet achieved. Results from separate analyses, one using only charged hadrons and the other using both charged and the neutral energy deposited in the EM calorimeter, are presented. Correlations with $\Sigma|P_T| \simeq E_T$, an event variable, are studied. An azimuthal asymmetry of the hadrons about the virtual photon is observed. 14 refs., 8 figs.

13631 (FNAL/C–91/25-E) **Vertex detection at the Tevatron.** Amidei, D. (Michigan Univ., Ann Arbor, MI (USA)); Shepard, P.; Tkaczyk, S. Fermi National Accelerator Lab., Batavia, IL (USA). 11 Jan 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9006267–27: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91009462. Source: OSTI; NTIS; INIS; GPO Dep.

Addition of vertex detectors to CDF and D0 will facilitate a rich program of beauty physics at the Tevatron, and may enable tags of B and τ which facilitate searches for top and other heavy objects. We also address the operational considerations of triggering and radiation protection, and speculate on possible directions for upgrades. 9 refs., 7 figs.

13632 (FNAL/C–91/26-E) **Study of vector boson decay and determination of the Standard Model parameters at hadronic colliders.** Amidei, D. Fermi National Accelerator Lab., Batavia, IL (USA). 11 Jan 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9006268–6: 10. international conference on physics in collision, Durham, NC (USA), 21-23 Jun 1990). Order Number DE91009463. Source: OSTI; NTIS; INIS; GPO Dep.

The power of the detectors and the datasets at hadronic colliders begins to allow measurement of the electroweak parameters with a precision that confronts the perturbative corrections to the theory. Recent measurements of M_Z, M_W, and sin θ_W by CDF and UA2 are reviewed, with some emphasis on how experimental precision is achieved, and some discussion of the import for the specifications of the Standard Model. 14 refs., 10 figs., 4 tabs.

13633 (INS-T–498, pp. 46-53) **Experiments with an internal target in the KEK PS tunnel.** Shimizu, Hajime (Yamagata Univ. (Japan). Faculty of Science). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

The momentum dependence of the p-p elastic analyzing power has been measured in small steps using an internal target during polarized beam acceleration from 1 to 3 GeV/c. The momentum bin size ranges from 5 to 18 MeV/c. The relative uncertainty of the analyzing power is typically less than 0.01 for each momentum bin. Narrow structures have been observed in the two-proton invariant mass distribution of the analyzing power. A brief discussion on the interpretation of the present results is also given. (author).

13634 (INS-T–498, pp. 107-114) **π^0-factory using TARN II.** Torikai, Kumataro (Tokyo Univ. (Japan). Inst. for Nuclear Study). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

The report discusses an effort at TARN II to increase the statistical accuracy of π^0 rare decay measurement by one order of magnitude or more by making use of good features of a coller ring. This type of decay provides useful data concerning the strong interaction, electromagnetic interaction and weak interaction. Then $\pi^-p \rightarrow \pi^0 n$ reaction and the $K^\pm \rightarrow \pi^\pm \pi^0$ reaction are currently used as π^0 source for measuring the π^0 rare decay. When the former reaction is used as π^0 source, major contributions to the background come from the $\pi^-p \rightarrow e^+e^-n$ reaction, $\pi^-p \rightarrow \gamma n$ reaction, and pair creation involving the resultant γ. Only the particles formed from decayed π^0 are measured in most π^0 rare decay experiments. When the latter reaction is used, on the other hand, decay processes involving two π^0s ($K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$) that occurs during the K decay make major contributions to the background. For Saturn, the $dp \rightarrow {}^3He\pi^0$ reaction caused by deuteron beam is planned to be used as π^0 source. The performance of TARN II π^0 source ($pd \rightarrow {}^3He\pi^0$) is compared with that of the above reactions, stressing the superiority of the use of the cooler ring. In TARN II, protons circulating in the cooler ring are planned to be employed as incident particles, together with an internal target, and pellet deuterons are used to cause the $pd \rightarrow {}^3He\pi^0$ reaction. This allows the reaction point to be determined with very high accuracy. (N.K.).

13635 (LAL–9035) **DM2 results on e^+e^- annihilation into multihadrons in the 1350-2400 MeV energy range.** Bisello, D. (Padua Univ. (IT). Ist. di Fisica); Busetto, G.; Castro, A.; Nigro, M.; Pescara, L.; Sartori, P.; Stanco, L.; Antonelli, A.; Baldini, R.; Biagini, M.E.; Calcaterra, A.; Schioppa, M.; Augustin, J.E.; Cosme, G.; Couchot, F.; Fulda, F.; GrosdidierDM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jun 1990. 25p. (CONF-900822–: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE91757079. Source: OSTI; NTIS (US Sales Only).

We present preliminary results on the study of e^+e^- annihilation into $\pi^+\pi^-\pi^+\pi^-$, $\pi^+\pi^-\pi^0\pi^0$, $\pi^+\pi^-\pi^0$, $\pi^+\pi^-\pi^+\pi^-\pi^0$, $K^+K^-\pi^+\pi^-$ and $K_s{}^0K^\pm\pi^{-+}$ in the 1350-2400 MeV energy range. Data have been collected with the DM2 detector at DCI, the Orsay colliding ring, and refer to about 2 pb^{-1} integrated luminosity.

13636 (LBL–30144) **Evidence for the emission of a massive neutrino in nuclear beta decay.** Norman, E.B. (Lawrence Berkeley Lab., CA (USA)); Sur, B.; Lesko, K.T.; Larimer, R.M.; Hindi, M.M.; Ho, T.R.; Luke, P.N.; Hansen, W.L.; Witort, J.T. Lawrence Berkeley Lab., CA (USA). Oct 1990. 11p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC03-76SF00098 ;FG05-87ER40314. (CONF-9010128–4: 14. Europhysics conference on nuclear physics: rare nuclear decays and fundamental processes, Bratislava (Czechoslovakia), 22-26 Oct 1990). Order Number DE91009737. Source: OSTI; NTIS; INIS; GPO Dep.

We have studied the β-spectrum of ^{14}C using a germanium detector containing a crystal with ^{14}C dissolved in it. We find a feature in the β-spectrum 17 keV below the endpoint which can be explained by the hypothesis that there is a heavy neutrino emitted in the β-decay of ^{14}C with a mass of 17 $\pm$ 2 keV and an emission probability of 1.40 $\pm$ 0.45%. In addition, we have studied the inner bremsstrahlung spectrum of ^{55}Fe and also find indications of the emission of a $\sim$ 17-keV neutrino. These results are consistent with observations of similar anomalies in the β-decays of ^3H and ^{35}S. 29 refs., 7 figs.

13637 (MPI-PAE/Exp.El.–232) **Measurement of the electroweak mixing angle by means of the τ-polarization asymmetry in the process $ee \rightarrow Z^0 \rightarrow \tau\tau$ $\tau \rightarrow \pi\nu$ on the Z^0 resonance.** Stiegler, U. Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik. Nov 1990. 117p. (In German). Order Number DE91756211. Source: OSTI; NTIS (US Sales Only); INIS.

In the present thesis the τ polarization asymmetry A_{pol} on the Z^0 resonance was measured by means of the pion decay channel: $A_{pol} = (2.42 \pm 25.4_{stat} \pm 9.6_{sys})\%$. The measurement was performed with the ALEPH detector at the LEP accelerator. The data set contains about 32000 Z^0 events. The integrated luminosity amounts to 1.2 pb^{-1}. Among 780 τ pairs 90 τ leptons in the pion decay channel were found. The measured polarization asymmetry leads at an assumed top mass of 100 GeV to an elctroweak mixing angle of θ_W of $\sin^2\theta_W = 0.245 \pm 0.032_{stat} \pm 0.012_{sys}$ and agrees with the standard model. At the planned increasement of the statistics at the ALEPH experiment to first $10^6 Z^0$ the statistical error of the electroweak mixing angle will decrease to 0.006. As explained in the following chapters with the method presented here at $10^6 Z^0$ an equally large systematic error is expected. The measurement of the systematic errors was performed with LEP data and by test measurements.

Errors, which were determined with LEP data, are proportional to the statistical error and do not limit by this the precision. At a number of about $10^6 Z^0$ events the uncertainties of the test measurements will predominate in the systematic error. The method presented in the present dissertation allows a measurement of the electroweak mixing angle with an error of about $4x10^{-3}$. (orig.).

13638 (PCCF-T-9001) **Study of heavy quarks production with ALEPH.** Perret, P. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire; Clermont-Ferrand-1 Univ., 63 - Aubiere (France). May 1990. 199p. (In French). Order Number DE91757085. Source: OSTI; NTIS (US Sales Only).

The first data collected by the ALEPH detector at LEP have provided the matter of this study concerning the measure of the partial widths of the Z boson decay into heavy quarks from an analysis of inclusive leptons spectrum. After a presentation of the expected Z decay width into bantib, we explain the phase during which the b quark becomes observable as a beautiful hadron and discuss the present model validity describing this transition by a comparison with the data. Come afterwards the beautiful mesons semileptonic decays description. A more specific work, the possibility of testing the B mesons semileptonic decay model with the D* polarisation measure, is also presented. By fitting the momentum-transverse momentum spectrum of the electrons observed in the hadronic Z decays, we measure the partial widths. We extract $Z \rightarrow$ bantib, first in an ample dominated by leptons coming from b decays, and then $Z \rightarrow$ bantib and $Z \rightarrow$ cantic simultaneously by a global fit of the electron spectrum, including also a determination of the heavy quarks fragmentation parameters in the Peterson framework. We have measured the ratio of the b partial width and the total hadronic width (0.212 ± 0.024) and that of the c (0.182 ± 0.070) in good agreement with the Standard Model. Statistic and systematic errors have comparable values.

13639 (SLAC-PUB-5428) **The future of tau physics and tau-charm detector and factory design.** Perl, M.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1991. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515. (CONF-910229-2: 6. Lake Louise winter institute (LLWI-6): topical workshop on particle physics - the factory era, Lake Louise (Canada), 17-22 Feb 1991). Order Number DE91009366. Source: OSTI; NTIS; INIS; GPO Dep.

Future research on the tau lepton requires large statistics, thorough investigation of systematic errors, and direct experimental knowledge of backgrounds. Only a tau-charm factory with a specially designed detector can provide all the experimental conditions to meet these requirements. This paper is a summary of three lectures delivered at the 1991 Lake Louise Winter Institute.

13640 (UIUC-HEPG-90-79) **A measurement of $\sin^2\theta_W$ from the forward-backward asymmetry in $p\bar{p} \rightarrow Z^0 \rightarrow e^+e^-$ interactions at $\sqrt{s} = 1.8$ TeV.** Hurst, P.T. Illinois Univ., Urbana, IL (USA). [1990]. 159p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76ER01195 ;AC02-76ER03064. Order Number DE91009528. Source: OSTI; NTIS; INIS; GPO Dep.

An analysis of the forward-backward asymmetry in Z^0 decays using data from the Collider Detector at Fermilab provides a measurement of $\sin^2\hat{\theta}_W$. The forward-backward asymmetry is measured to be $(5.2 \pm 5.9\ (\text{stat}) \pm 0.4\ (\text{sys}))\%$, which implies $\sin^2\hat{\theta}_W = 0.228_{-0.015}^{+0.017}\ (\text{stat}) \pm 0.002\ (\text{sys})$, after QCD, QED, and weak corrections. When higher order weak corrections are included, the measured value of $\sin^2\hat{\theta}_W$ is consistent with previous measurements over a broad range of top quark masses. 59 refs., 58 figs., 9 tabs.

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Refer also to citation(s) 13621, 13685, 13729

13641 (BNL-45157) **Semi-leptonic decays on the lattice: The exclusive 0^- to 0^- case.** Bernard, C.W. (California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics); El-Khadra, A.X.; Soni, A. Brookhaven National Lab., Upton, NY (USA). [1990]. 52p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (NSF-ITP-90-147). Order Number DE91009436. Source: OSTI; NTIS; INIS; GPO Dep.

We present our results for the meson form factors of several semi- leptonic decays. They are computed from the corresponding matrix elements evaluated on the lattice as ratios of Greens functions. The renormalization of the local operators is calculated nonperturbatively. The dependence of the form factors on the four momentum transfer q^2 is studied by injecting external three momenta to the initial and final state mesons. We study the pseudoscalar decays $K \rightarrow \pi\ell\nu$, $D \rightarrow K\ell\nu$, $D \rightarrow \pi\ell\nu$, $D_s \rightarrow \eta\ell\nu$ and $D_s \rightarrow K\ell\nu$ on different lattices. We also analyze scaling, finite size and SU(3) symmetry breaking effects. The uncertainties in some lattice parameters, e.g. a^{-1}, as a source of systematic errors in this calculation are discussed. 35 refs., 15 figs., 13 tabs.

13642 (CONF-8410224-14) **Heavy neutrinos and new bosons at the SSC.** Kayser, B. (National Science Foundation, Washington, DC (USA). Div. of Physics); Deshpande, N.; Gunion, J.F. California Univ., Davis, CA (USA). [1984]. 34p. Sponsored by USDOE,. DOE Contract FG03-84ER13274. From AIP conference on neutrino mass and gauge structure of weak interaction; Cable, WI (USA); 24-27 Oct 1984. Order Number DE91008163. Source: OSTI; NTIS; INIS; GPO Dep.

Methods for seeking and studying heavy neutrinos and new W bosons at the SSC are considered. Such particles are predicted by left-right symmetric models. Their properties and experimental signatures are analyzed. 25 refs., 5 figs.

13643 (CONF-9006275-3) **Dynamical models of $B \rightarrow \psi/J$ K_s^*.** Ward, B.F.L. (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy). International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 6p. Sponsored by USDOE, Washington, DC (USA); International Atomic Energy Agency, Vienna (Austria). DOE Contract AS05-76ER03956 ;AC03-76SF00515. (UTHEP-90-1001;IC-90/271). From Workshop on physics and detector issues for a high-luminosity asymmetric B factory; Stanford, CA (USA); 4-8 Jun 1990. Order Number DE91009198. Source: OSTI; NTIS; INIS; GPO Dep.

An issue of some interest in the general theory of CP violation on B meson decay is the relative admixture of even and odd final CP eigenstates in $B \rightarrow \psi/JK^*_s$. For example, dominance of one sign of CP in this decay would increase the available modes for measuring the CP violation in the respective B meson decays in a beauty factory by a factor ~2.5 and, hence, would decrease the luminosity requirements for such a factory from the CP violation perspective. Here, we therefore study this relative admixture in several dynamical models of the respective decay. We are encouraged by our findings. 12 refs., 3 figs.

13644 (DESY-90-098) **W, Z plus jet production at panti p colliders.** Brandt, F.T. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik); Kramer, G.; Nyeo Sulong. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Aug 1990. 24p. Order Number DE91756513. Source: OSTI; NTIS (US Sales Only); INIS.

We have calculated cross sections for the production of W± and Z bosons in association with 1 and 2 jets at panti p collider energies. The rates for these processes in second-order QCD are compared with jet rates measured by UA1 and CDF. (orig.).

13645 (DESY-90-099) **Baryon number violation in high energy collisions.** Farrar, G.R. (Rutgers - the State Univ., Piscataway, NJ (USA). Dept. of Physics and Astronomy); Meng, R. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Aug 1990. 11p. Contract PHY-88-18535. (RU-90-40). Order Number DE91754943. Source: OSTI; NTIS (US Sales Only); INIS.

We study the phenomenology of baryon number violation induced by electroweak instantons. We find that if the naive-instanton amplitudes were valid for arbitrarily high energies, the event rate at the SSC would be a few per hour, with a typical event consisting of 3 'primary' antileptons and 7 'primary' antiquark jets, accompanied by $\simeq$ 85 electroweak gauge bosons, having a sharp threshold in the total sub-energy at about 17 TeV. We describe how to establish their electroweak-instanton-induced origin. The naive instanton approximation is known to overestimate the rate for these processes, so this work focusses attention on the

need for more accurate calculations, and for a calculational method which is appropriate when the energy of the initial particles is above the sphaleron energy. (orig.).

13646 (DESY–90-101) **Baryons in the heavy quark effective theory.** Mannel, T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Roberts, W.; Ryzak, Z. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Aug 1990. 14p. Grant PHY-87-14654;DE-AC-76ER03064. (HUTP–90/A047). Order Number DE91754941. Source: OSTI; NTIS (US Sales Only); INIS.

We show how to incorporate baryons in the heavy quark effective theory. A convenient formalism is exhibited and applied to semileptonic weak decays of heavy baryons and to exclusive production of heavy baryons in e^+e^- annihilation. (orig.).

13647 (DESY–90-106) **Isospin analysis of CP asymmetries in B decays.** Gronau, M. (Technion-Israel Inst. of Tech., Haifa (Israel)); London, D. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 10p. (UdeM-LPN-TH–24). Order Number DE91754942. Source: OSTI; NTIS (US Sales Only); INIS.

There is some theoretical uncertainty in the predictions for CP violating hadronic asymmetries in neutral B decays to CP eigenstates due to the existence of penguin diagrams. Using isospin relatins, we show that it is possible to remove this uncertainty for the decays $B_d^0 \rightarrow \pi\pi$, up to a 4-fold ambiguity. (orig.).

13648 (DESY–90-107) **Comparison of parton distributions and structure functions for the proton.** Abramowicz, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Charchula, K.; Krawczyk, M.; Levy, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 13p. Order Number DE91756510. Source: OSTI; NTIS (US Sales Only); INIS.

A comparative study of the most popular parton parametrizations is presented. The individual parton distributions as well as the F_2 structure function are discussed with a particular emphasis on the low x region, $10^{-4} < x < 10^{-2}$. The predictions of these parametrizations for the F_2 structure function have a wide spread which persists also in the HERA kinematical region. (orig.).

13649 (DOE/ER/40224–136) **Nonleptonic B decays involving b → u, d transitions.** Deshpande, N.G. (Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science); Panose, K.; Trampetic, J. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Sep 1989. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–422). Order Number DE91009526. Source: OSTI; NTIS; INIS; GPO Dep.

The decay rates of the B-meson through b → u and b → d transition into π, ρ, ω and γ systems are studied. The decay rate into a photon + meson final state is calculated via $\rho^0 \rightarrow \gamma$ and $\omega \rightarrow \gamma$ conversion. 5 refs., 1 tab.

13650 (DOE/ER/40224–139) **Loop induced B decays.** Deshpande, N.G. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Nov 1989. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–429). Order Number DE91009585. Source: OSTI; NTIS; INIS; GPO Dep.

Higher order electroweak effects can be effectively tested in B decays involving the short distance flavor changing (b→s) transition. We estimate the exclusive rates involving a virtual photon like $B \rightarrow K\ 0^+0^-$ and real photon like $B \rightarrow K^*\gamma$. The effects of QCD enhancement, and the resulting e-μ rate difference are discussed. Decays mediated by gluon exchange are also discussed. 13 refs., 1 tab.

13651 (DOE/ER/40224–141) **Multifractal structure of multiparticle production in the branching models.** Chiu, C.B. (Texas Univ., Austin, TX (USA)); Hwa, R.C. Oregon Univ., Eugene, OR (USA). Jan 1990. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–431). Order Number DE91009584. Source: OSTI; NTIS; INIS; GPO Dep.

A procedure is described for the multifractal analysis of data on multiparticle production obtained at high energy either in experiment or in Monte Carlo simulation. It is shown how the spectrum $f(\alpha)$ of the rapidity-density index α can be determined from the multiplicity fluctuation of the rapidity distribution, as the resolution is changed. The branching model is used to illustrate the procedure. It is found that the ϕ^3 model has a narrower $f(\alpha)$ than the gluon model, suggesting that multifractality is a useful arena for confrontation between theory and experiment. 13 refs., 2 figs.

13652 (DOE/ER/40224–143) **Comment on $Z \rightarrow \pi^0\gamma$ and the axial anomaly.** Deshpande, N.G.; Pal, P.B. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Jan 1990. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–433-R). Order Number DE91009583. Source: OSTI; NTIS; INIS; GPO Dep.

We examine the recent claim of a possible enhancement of the process $Z \not\rightarrow \pi^0\gamma$ through the axial anomaly. A critical analysis of the question reveals the deficiency in the proof, and no enhancement is seen in a model calculation. 4 refs.

13653 (DOE/ER/40224–144) **Pseudo-Dirac neutrinos in the left-right model.** Pal, P.B. (Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science). Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Feb 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–434). Order Number DE91009582. Source: OSTI; NTIS; INIS; GPO Dep.

We present a very simple and economical left-right symmetric model, based on the gauge group $SU(2)_L \times SU(2)_R \times U(1)_{B-L}$, which naturally yields pseudo-Dirac neutrinos. In the model, neutrinos can have transition moments large enough to solve the solar neutrino problem. The radiative decay rate can also be large. 11 refs., 3 figs.

13654 (DOE/ER/40224–146) **The one-jet inclusive cross section at order α_s^3: Quarks and gluons.** Ellis, S.D. (Washington Univ., Seattle, WA (USA). Dept. of Physics); Kunszt, Z.; Soper, D.E. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Feb 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–436). Order Number DE91009580. Source: OSTI; NTIS; INIS; GPO Dep.

The next-to-leading order inclusive jet cross section is calculated including both quarks and gluons. The general structure of the dependence of the cross section on the explicit jet definition and on the choice of the renormalization scale μ^2 is found to be very similar to the case of gluons only calculated earlier. The resulting cross section is shown to involve a much reduced theoretical uncertainty compared to the lowest order result. First comparisons with experimental data are also exhibited. 15 refs., 3 figs.

13655 (DOE/ER/40224–149) **Gauge hierarchy and long range forces.** Pal, P.B. (Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science); Keung, Wai-Yee; Chang, D. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–439;NUHEP-TH–90-12;CONF-900135–21: 15. general meeting of the Division of Particles and Fields of the American Physical Society (APS), Houston, TX (USA), 3-6 Jan 1990). Order Number DE91009578. Source: OSTI; NTIS; INIS; GPO Dep.

With the aid of simple examples, we show how a long range attractive force can arise in a gauge theory with a hierarchy. The force is due to the exchange of a Higgs boson whose mass and matter couplings are both naturally suppressed by the hierarchical mass ratio. Such bosons appear if there is an accidental global symmetry in the low-energy renormalizable Lagrangian after the high energy symmetry breaking. 6 refs.

13656 (DOE/ER/40224–150) **An overview on intermittency in high-energy collisions.** Hwa, R.C. Oregon Univ., Eugene, OR (USA). Apr 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–440;CONF-9003162–3: Santa Fe workshop on intermittency in high energy collisions, Santa Fe, NM (USA), 18-21 Mar 1990). Order Number DE91009575. Source: OSTI; NTIS; INIS; GPO Dep.

The status of itermittency in high-energy collisions is very briefly summarized. The connection between itermittency and multifractality is discussed. A speculation on how the multifractal analysis can be used to reveal a possible signature of quark-gluon plasma in relativistic heavy-ion collisions is given. 26 refs.

13657 (DOE/ER/40224–151) **Nonstatistical component of the multifractal spectral function.** Chiu, C.B. (Texas Univ., Austin, TX (USA)); Fialkowski, K.; Hwa, R.C. Oregon Univ., Eugene, OR (USA). Sep 1990. 11p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract FG06-85ER40224 ;FG05-85ER40200. Grant INT-8902224. (OITS–441). Order Number DE91009574. Source: OSTI; NTIS; INIS; GPO Dep.

In the multifractal analysis of multiplicity fluctuation in high energy collisions, the statistical contribution to the spectrum function $f(\alpha)$ is calculated using the multinomial distribution. The nonstatistical component can be extracted using a subtraction scheme that is consistent with multifractality. A simple cluster model is considered for illustration. 7 refs., 2 figs.

13658 (DOE/ER/40224–152) **Intermittency and multifractals in branching models.** Chiu, C. (Texas Univ., Austin, TX (USA)); Hwa, R.C. Oregon Univ., Eugene, OR (USA). Jun 1990. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224 ;FG05-85ER40200. (DOE/ER/40200–222;OITS–442;CONF-9003162–4: Santa Fe workshop on intermittency in high energy collisions, Santa Fe, NM (USA), 18-21 Mar 1990). Order Number DE91009573. Source: OSTI; NTIS; INIS; GPO Dep.

The study of multiplicity fluctuation in multiparticle production at high energy has revealed self-similar properties conjectured by Bialas and Peschanski who referred the phenomenon as intermittency. This has opened up the possibility of more stringent test on the dynamical models describing multiparticle production. Furthermore, as conjectured earlier by Hwa it also provides a strong hint on the possible existence of fractal properties in such production processes. In this talk we would like to present our recent work on the intermittency analysis and multifractal analysis based on branching models. 7 refs., 7 figs.

13659 (DOE/ER/40224–153) **Multifractal signal of quark matter.** Hwa, R.C. Oregon Univ., Eugene, OR (USA). Jun 1990. 2p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–443). Order Number DE91009572. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss how the multifractal structure of multiplicity fluctuations in relativistic heavy-ion collisions can be used as a possible signal of quark-matter formation.

13660 (DOE/ER/40224–155) **Cluster cascading in the geometrical branching model.** Chen, Wei R. (Oklahoma School of Science and Mathematics, Oklahoma City, OK (USA)); Hwa, R.C.; Wang, Xin-Nian. Oregon Univ., Eugene, OR (USA). Aug 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224 ;AC03-76SF00098. (LBL–29335;OITS–445). Order Number DE91009571. Source: OSTI; NTIS; INIS; GPO Dep.

The geometrical branching model is further developed in a direction that allows the branching part to be implemented by a Monte Carlo scheme of cascading cluster decays. A universal mass distribution is adopted for the determination of cluster masses. Good agreements with data on multiplicity distribution and average multiplicity are achieved. 15 refs., 3 figs.

13661 (DOE/ER/40224–156) **Multifractal properties of multiparticle production.** Hwa, R.C. Oregon Univ., Eugene, OR (USA). Jun 1990. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–446;CONF-9005245–6: International workshop on correlations and multiparticle production (CAMP), Marburg (Germany, F.R.), 14-16 May 1990). Order Number DE91009570. Source: OSTI; NTIS; INIS; GPO Dep.

The language of multifractals is reviewed for the study of multiplicity fluctuations in high-energy collisions. Connection with intermittency is discussed. Analysis using the G-moments is introduced. Various issues related to the multifractal analysis are briefly mentioned. They include the size of resolution width, statistical background, and the application to the diagnostics of quark-gluon plasma. 17 refs.

13662 (DOE/ER/40224–157) **Universal multifractality in multiparticle production.** Florkowski, W.; Hwa, R.C. Oregon Univ., Eugene, OR (USA). Sep 1990. 27p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract FG06-85ER40224. Grant INT-8902224. (OITS–447). Order Number DE91009568. Source: OSTI; NTIS; INIS; GPO Dep.

The G moments for the multifractal analysis of multiparticle production are investigated in a model-independent way. By successive bin splitting and assuming the existence of a multiplicity splitting function that depends on multiplicity, but applicable at all steps of the splittings, we study the ergodicity of horizontal- and vertical-averaging, and derive a universality relation of the G moments. It relates the G moments for different initial multiplicities to a common scaling function $\Gamma_q(\xi)$. The experimental verification of this scaling property would, on the one hand, signify self-similarity in the data, and on the other, provide a convenient function for comparison not only among different experiments, but also between theory and experiment. 20 refs., 3 figs.

13663 (DOE/ER/40423–12-P90) **Elastic amplitudes and power corrections in QCD.** Botts, J. (Washington Univ., Seattle, WA (USA). Dept. of Physics); Qiu, J.; Sterman, G. Washington Univ., Seattle, WA (USA). Dept. of Physics. [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. (ITP-SB–90-68;CONF-900601–25: 12. PANIC international conference on particles and nuclei, Cambridge, MA (USA), 24-29 Jun 1990). Order Number DE91009609. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss two power-suppressed quantities in hadronic scattering: elastic amplitudes at fixed angles, and power corrections to inclusive hadronic cross sections. Generalized factorization theorems allow us to determine the asymptotic behavior of elastic scattering, and to relate $1/Q^2$ corrections in deeply inelastic scattering and the Drell-Yan process. 13 refs.

13664 (DOE/ER/40423–15) **Exploring glueball wavefunctions on the lattice.** Gupta, R. (California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics); Patel, A.; Baillie, C.F. Washington Univ., Seattle, WA (USA). Dept. of Physics. Dec 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. (NSF-ITP–90-206;LA-UR–90-2996). Order Number DE91009614. Source: OSTI; NTIS; INIS; GPO Dep.

We calculate the string tension and 0^{++} and 2^{++} glueball masses in pure gauge QCD using an improved lattice action. We compare various smearing methods, and find that the best glueball signal is obtained using smeared Wilson loops of size about 0.5 fm. Our results for mass-ratios, $m_0{}^{++}/\sqrt{\sigma} = 3.5(3)$ and $m_2{}^{++}/m_0{}^{++} = 1.6(2)$, are consistent with those computed with the simple plaquette action. 17 refs., 4 figs., 5 tabs.

13665 (DOE/ER/40423–16-P90) **Q → qZ decays at Tevatron and SSC energies.** Agrawal, P. (Washington Univ., Seattle, WA (USA). Dept. of Physics); Ellis, S.D.; Hou, Wei-Shu. Washington Univ., Seattle, WA (USA). Dept. of Physics. Sep 1990. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. Order Number DE91009566. Source: OSTI; NTIS; INIS; GPO Dep.

The possible existence of a new heavy quark Q that decays predominantly via the flavor changing neutral current transition Q → qZ is discussed. Candidates include a fourth generation charge –1/3 quark, or a more exotic vector-like quark. Such particles are interesting both as extensions of the Standard Model and due to their unique decay modes. The primary experimental indication of the pair production and subsequent decay of quarks is ZZ pair production at an essentially strong interaction rate. This mode can then constitute an unexpected background to the searches for other particles. In particular the channel $Q\bar{Q} \rightarrow ZZ + X$ can generate a serious background to the search for the Higgs boson via the $H^0 \rightarrow ZZ$ mode at the SSC. Thus it is essential to search for such new heavy quarks at the Tevatron. Possible detection signatures for this purpose are discussed. 24 refs. , 1 fig., 3 tabs.

13666 (DOE/ER/40423–17-P90) **Color transparency and landshoff multiple scattering processes.** Botts, J. Washington Univ., Seattle, WA (USA). Dept. of Physics. [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. Order Number DE91009615. Source: OSTI; NTIS; INIS; GPO Dep.

In the following, the leading and nonleading contributions to fixed angle hadron-hadron elastic scattering are included in a qualitative analysis of T(s), the transparency. A simple model is given to predict the center of mass energies at which a target nuclei will become transparent to hard and triple (Landshoff) scattered protons. 11 refs., 6 figs.

13667 (DOE/ER/40423–20) **Staggered weak matrix element miscellany.** Sharpe, S.R. (California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics). Washington Univ., Seattle, WA (USA). Dept. of Physics. Nov 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. (NSF-ITP–90-204;CONF-901072–11: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990). Order Number DE91009586. Source: OSTI; NTIS; INIS; GPO Dep.

I report on work, done with Rajan Gupta and Greg Kilcup, using staggered fermions to study weak matrix elements in quenched QCD. I give an update on the $\Delta I = 1/2$ rule on matrix elements relevant for ϵ'. I show results of a study of the dependence of B_K on non-leading terms in the chiral expansion. I present our results for B_K from quenched calculation at $\beta = 6.4$ on $32^3 \times 48$ lattices, based on ensemble of 12 configurations. 15 refs., 5 figs.

13668 (DOE/ER/40423–21) **I = 2 pion scattering length and quenched staggered spectrum.** Sharpe, S.R. (California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics). Washington Univ., Seattle, WA (USA). Dept. of Physics. Nov 1990. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. (NSF-ITP–90-205;CONF-901072–12: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990). Order Number DE91009590. Source: OSTI; NTIS; INIS; GPO Dep.

I report on a study of quenched QCD using staggered fermions being done with Rajan Gupta and Greg Kilcup. We calculate the I = 2 pion scattering length at $\beta = 5.7$ and 6, and find agreement with predictions from the chiral Lagrangian. I mention highlights of our spectrum calculation, including preliminary results at $\beta = 6.4$. 8 refs., 2 figs.

13669 (DOE/ER/40423–22) **Constraints on isospin breaking in the light quark sea from the Drell- Yan process.** Ellis, S.D.; Stirling, W.J. Washington Univ., Seattle, WA (USA). Dept. of Physics. Nov 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. Order Number DE91009611. Source: OSTI; NTIS; INIS; GPO Dep.

One possible interpretation of recent deep inelastic scattering data applied to the Gottfried sum rule is that SU(2) isospin symmetry is violated in the light quark sea in the proton, i.e., $\bar{u} \neq d$. The data can equally well be described by retaining SU(2) symmetry but postponing the onset of Regge behavior to much smaller x values than are currently samples experimentally. We show how the Drell-Yan process can provide definitive, discriminating information on this issue. We suggest a new Drell-Yan experiment, which should prove decisive, and show how existing data may already rule out the isospin-breaking hypothesis. 13 refs., 6 figs.

13670 (DOE/ER/40423–24) **Asymptotic perturbative QCD in elastic scattering, color transparency and A_{NN}.** Botts, J. Washington Univ., Seattle, WA (USA). Dept. of Physics. [1989]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. Order Number DE91009612. Source: OSTI; NTIS; INIS; GPO Dep.

Sorting out the various perturbative contributions to wide angel elastic hadron-hadron scattering has been the subject of recent enquiry. Distinguishing the various contributions are the transverse size of the external hadrons and the interaction region and restrictions on the internal momenta flows. For wide angle elastic hadron-hadron scattering, the interaction between two types of perturbative processes, multiple and single scattering, can be the source of interference phenomena and interesting physics. In the following, after a brief description of the leading and non-leading processes, we shall give a picture of what perturbative QCD may have to say about elastic scattering, color transparency and the spin asymmetry, A_{NN}. 9 refs., 5 figs.

13671 (INIS-mf–12791) **Theoretical calculations for electron proton scattering.** Horst, M. van der Jr. Amsterdam Univ. (Netherlands). 21 Feb 1990 107p. Order Number DE91622150. Source: OSTI; NTIS (US Sales Only); INIS.

Includes summary in Dutch.

Within an extension of the Higgs structure of the standard model the production of charged Higgs bosons at the ep collider HERA is possible. However it is found that the total production rates are very small. For example, if a mass of 15 GeV is assumed , at most 10 events can be observed at HERA. Therefore it will be clear that the actual performance of HERA must be monitored accurately. This thesis is concerned with the computation of the cross section of $e^-p \rightarrow \gamma e^-p$ reaction which has been proposed to be a luminosity monitor for HERA. In ch. 3 the pro-cess is computed at lowest order. Ch. 4 presents the computation of radiative corrections to the process which consist of the virtual corrections and the corrections due to Bremsstrahlung photons. This amounts to computing the cross section of the process $e^-p \rightarrow \gamma\gamma\ e^-p$, and must be included to cancel infrared divergent terms in the virtual corrections in the usual way. In ch. 5 a concise expression for the trace of gamma matrices in four dimensions is presented. This expression can be useful in writing a matrix element (at tree level) in terms of contractions of two different tensors. The expression found can be useful in an algebraic manipulation programme. An example is given how the results can be used in a physical process. (H.W.).55 refs.; 11 figs.

13672 (INIS-mf–12794) **One-loop calculations with massive particles.** Oldenborgh, G.J. van. Amsterdam Univ. (Netherlands). 15 Oct 1990 120p. Order Number DE91623062. Source: OSTI; NTIS (US Sales Only); INIS.

Includes summary in Dutch.

In this thesis some techniques for performing one-loop calculations with massive particles are presented. Numerical techniques are presented necessary for evaluating one-loop integrals which occur in one-loop calculations of photon-photon scattering. The algorithms have been coded in FORTRAN (to evaluate the scalar integrals) and the algebraic language FORM (to reduce the tensor integrals to scalar integrals). Applications are made in the theory of the strong interaction, QCD, i.e. in handling one-loop integrals with massive particles, in order to regulate the infinities by mass parameters encountered in this theory. However this simplifies the computation considerably, the description of the proton structure functions have to be renormalized in order to obtain physical results. This renormalization is different from the published results for the gluon and thus has to be redone. The first physics results that have been obtained with these new methods are presented. These concern heavy quark production in semi-leptonic interactions, for instance neutrino charm production and top production at the electron-proton (ep) collider HERA and the proposed LEP/LHC combination. Total and differential cross-sections for one-loop corrections to top production at the HERA and proposed LEP/HLC ep colliders are given and structure functions for charmed quark production are compared with previously published results. (author). 58 refs.; 18 figs.; 5 tabs.

13673 (SLAC-PUB–5419) **Physics at e^+e^- factories.** Lueth, V. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); MacFarlane, D.B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Feb 1991. 24p. Sponsored by USDOE,. DOE Contract AC03-76SF00515. (CONF-9006267–24: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91008496. Source: OSTI; NTIS; INIS; GPO Dep.

Feasible designs are well advanced for high-luminosity e^+e^- storage rings which produce $B^0\bar{B}^0$ pairs either at rest or, in what appears to be a more promising option, boosted in the detector frame. Facilities which could provide samples of 30–100 fb^{-1} per year on the $\Upsilon(4S)$ will be proposed in early 1991. Here we examine the principal physics goal of such B Factories, namely CP violation in the b system. Methods in a variety of channels, estimated event samples, and detector requirements are all considered. We conclude that the physics argument for an e^+e^- B Factory is well documented, and compelling. 50 refs., 22 figs., 10 tabs.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 13620, 13653, 13655

13674 (DOE/ER/40224–145) **Radiative gauge symmetry breaking in an N=2 superconformal string compactification.** Zoglin, P. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Feb 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–435). Order Number DE91009581. Source: OSTI; NTIS; INIS; GPO Dep.

We study the intermediate scale gauge symmetry breaking in a four generation heterotic string model based on Gepner's N = 2 superconformal string compactifications. The visible sector gauge group, at the planck scale, is $SU(3)_C \otimes SU(2)_L \otimes SU(2)_R \otimes U(1)' \otimes U(1)''$. Putting in by hand soft supersymmetry breaking terms, we evolve the masses and couplings down from the planck scale using the renormalization group equations and minimize the effective potential. We find that the $U(1)''$ gauge group is broken at a scale of approximately 10^{15} Gev. 14 refs.

13675 (DOE/ER/40224–148) **Mass scales and symmetry breaking in SU(15) grand unification.** Pal, P.B. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. Apr 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–438). Order Number DE91009579. Source: OSTI; NTIS; INIS; GPO Dep.

We carefully reanalyzed the recently suggested grand unified model based on the gauge group SU(15). We find that the unification scale is not as low as predicted before. We discuss various bounds on the scales imposed by rare processes. We point out that baryon number is part of the gauge symmetry of the model. We propose changes that get rid of gauge anomalies and a massless gauge boson corresponding to the unbroken baryon number symmetry present in the original model. 8 refs., 4 figs.

13676 (LBL–29780) **On null tests of time-reversal invariance.** Conzett, H.E. Lawrence Berkeley Lab., CA (USA). Oct 1990. 5p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-900924–15: 9. international symposium on high energy spin-physics, Bonn (Germany, F.R.), 10-15 Sep 1990). Order Number DE91009114. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. T INVARIANCE/testing; TESTING; SCATTERING; SPIN; CROSS SECTIONS

6454 Field Theory

Refer also to citation(s) 13594, 13655, 13674, 13675

13677 (ANL-HEP-CP–90-58) **Choosing the factorization/renormalization scale in perturbative QCD calculations.** Collins, J.C. (Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Physics). Argonne National Lab., IL (USA). High Energy Physics Div. [1990]. 7p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-9003161–13: 25. Rencontres de Moriond on QCD and hadronic interactions conference, Les Arcs (France), 4-11 Mar 1990). Order Number DE91008726. Source: OSTI; NTIS; INIS; GPO Dep.

It is important in perturbative QCD calculations to estimate the errors due to uncalculated higher order corrections. An inappropriate choice of the renormalization and factorization scales can lead to unnecessarily large higher order corrections. A method for systematically investigating these issues is suggested. it involves examining the integrands of Feynman graphs as a function of $\kappa_\perp$. A rationale for choosing a sensible range of the scale parameter(s) is suggested. A by product is a physical interpretation of the scales in the MS and $\overline{MS}$ schemes. 8 refs., 5 figs.

13678 (BONN-HE–90-12) **Estimation of the central charge by Monte Carlo simulations.** Lauwers, P.G.; Schuetz, G. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Nov 1990. 12p. Order Number DE91756664. Source: OSTI; NTIS (US Sales Only); INIS.

Using an idea put forward by J.L. Cardy, we demonstrate how to obtain a good estimate for the central charge c of a conformally invariant field theory by Monte Carlo simulations of the corresponding statistical model away from criticality, but in the scaling region; the two-dimensional 3-state Potts model in a magnetic field is used as a test case. Determining c in this way has become feasible because of a big increase in the availability of computational power and because of the invention of stochastic cluster algorithms, that allow an efficient simulation of statistical models near criticality. This method provides a reliable way to determine c for models, for which the other known methods have failed up to now. (orig.).

13679 (DESY–90-104) **Renormalisation group flow in QED.** Rakow, P.E.L. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Aug 1990. 10p. (CONF-9007180–: 1990 international workshop on strong coupling gauge theories and beyond, Nagoya (Japan), 28-31 Jul 1990). Order Number DE91756511. Source: OSTI; NTIS (US Sales Only); INIS.

I investigate the renormalisation group flow in QED using a set of truncated Schwinger-Dyson equations which include the effects of vacuum polarisation. I find a second order chiral phase transition, with mean field critical exponents, and with α_r=0 at the critical point. The electromagnetic β-function is positive, and does not have a zero at the phase transition. When a four-fermion interaction is added the only fixed points present are the free theory and the Nambu-Jona-Lasinio theory. These results suggest that QED is a trivial theory. (orig.).

13680 (DESY–90-105) **A $U(1)_L$ x $U(1)_R$ symmetric Yukawa-model in the phase with spontaneously broken symmetry.** Lin, L. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Montvay, I.; Wittig, H.; Muenster, G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 42p. Order Number DE91754933. Source: OSTI; NTIS (US Sales Only); INIS.

The lattice regularized $U(1)_L$ x $U(1)_R$ symmetric scalar-fermion model with a mirror pair of fermion fields is investigated in the phase with spontaneously broken symmetry. The reflection positivity condition, ensuring unitarity in Minkowski-space, is proven in this lattice formulation in a wide range of bare parameters. Numerical Monte Carlo calculations with dynamical fermions are performed on 4^3x8, 4^3x16 and 6^3x16 lattices at moderately strong bare Yukawa-couplings and at very small and infinite bare quartic scalar coupling. It is shown that not only the lattice fermion doublers but also the mirror fermion can be made heavy, and therefore the light fermion spectrum is 'chiral' as in the standard model. The 'vacuum stability' bound on the Higgs-boson mass is discussed in lattice perturbation theory and non-perturbatively. It implies that for heavy mirror fermions the Higgs-boson mass has to be close to the non-perturbative upper limit. (orig.).

13681 (DESY–90-108) **The eigenvalue spectra in Z(2) x Z(2) and SU(2) x SU(2) fermion-Higgs models.** Barbour, I. (Glasgow Univ. (UK). Dept. of Physics and Astronomy); Bock, W.; De, A.K.; Trappenberg, T.; Davis, C.; Henty, D.; Smit, J. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 27p. (HLRZ–90-042;GUPTA–90/5-1). Order Number DE91754934. Source: OSTI; NTIS (US Sales Only); INIS.

We present an analysis of the eigenvalue spectra of the Dirac operator M and related operators M' and M^+M in an SU(2) x SU(2) and in a simpler Z(2) x Z(2) Fermion-Higgs model in the quenched approximation. We especially study the spectra in the symmetric and broken symmetry phases along the crossover line which was recently discovered in these models in numerical simulations. It turns out that in the symmetric phases of both models zero modes emerge along the crossover line in the thermodynamic limit. In the case of the Z(2) model the zero modes follow the crossover line into the broken symmetry phase whereas in the case of the SU(2) model they appear to stop at the phase transition line between the symmetric and the broken phases. Finally from the eigenvalue distribution we find an useful rough estimate of the fermion mass. (orig.).

13682 (INFN/AE–90/14) **New quantum group and hyperplane from WZW and Toda models.** Dabrowski, L. Istituto Nazionale di Fisica Nucleare, Trieste (Italy). 31 Oct 1990. 8p. Sponsored by Nation. (CONF-9009352–1: 9. convegno nazionale di relativita generale, Capri (Italy), 25-28 Sep 1990). Order Number DE91008961. Source: OSTI; NTIS (US Sales Only); Istituto Nazionale di Fisica Nucleare, Via Celoria 16, 20133 Milano, Italy.

A new quantum group and the calculus on quantum hyperplane is described, which are associated to R-matrix describing the braiding of certain chiral Toda fields. The classical limit of these structures relates to Poisson brackets of certain chiral WZW fields. 17 refs.

13683 (LA-UR-91-662) **Introduction and overview to some topics in perturbative QCD and their relationship to non perturbative effects.** West, G. Los Alamos National Lab., NM (USA). [1990]. 24p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9005251-2: Workshop on quark-gluon structure of hadrons and nuclei, Shanghai (China), 28 May - 1 jun 1990). Order Number DE91008604. Source: OSTI; NTIS; INIS; GPO Dep.

The main thrust of this talk is to review and discuss various topics in both perturbative and non-perturbative QCD that are, by and large, model independent. This inevitably means that we shall rely heavily on the renormalization group and asymptotic freedom. Although this usually means that one has to concentrate on high energy phenomena, there are some physical processes even involving bound states which are certainly highly non-perturbative, where one can make some progress without becoming overly model independent. Experience with the EMC effect, where there are about as many "explanations" as authors, has surely taught us that it may well be worth returning to "basics" and thinking about general properties of QCD rather than guessing, essentially arbitrarily, what we think is its low energy structure. No doubt we shall have to await further numerical progress or for some inspired theoretical insight before we can, with confidence, attack these extremely difficult problems. So, with this in mine, I shall review a smattering of problems which do have a non-perturbative component and where some rather modest progress can actually be made; I emphasize the adjective "modest"!

13684 (LRP-411/90, pp. 13-32) **A modified electromagnetic wave equation.** Llobet, X. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Appert, K.; Vaclavik, J. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Aug 1990. (CONF-900807--: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 27-31 Aug 1990). In *Invited and contributed papers presented at the joint Varenna-Lausanne international workshop on 'theory of fusion plasmas'.* 57p. Order Number DE91003074. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this paper is to find an alternative to the usual electromagnetic wave equation: that is, we want to find a different equation with the same solutions. The final goal is to solve electromagnetic problems with iterative methods. The curl curl operator that appears in the electromagnetic wave equation is difficult to invert numerically, and this cannot be done iteratively. The addition of a higher order term that emphasizes the diagonal terms in the operator may help the solution of the problem, and the new equation should be solvable by an iterative algorithm. The additional mode is suppressed by suitable boundary conditions. (author) 5 figs., 9 refs.

13685 (NIKHEF-H-90-15) **FF. A package to evaluate one-loop Feynman diagrams.** Oldenborgh, G.J. van (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Sep 1990. 20p. Order Number DE91623477. Source: OSTI; NTIS (US Sales Only); INIS.

A short description and a user's guide of the FF package are given. This package contains routines to evaluate numerically the scalar one-loop integrals occurring in the evaluation in one-loop Feynman diagrams. The algorithms chosen are numerically stable over most parameter space. (author). 5 refs.; 1 tab.

13686 (UWThPh-1990-38) **On the relation between the geometric phase and the Schwinger term.** Falkensteiner, P.; Grosse, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 5 Nov 1990. 5p. Order Number DE91621761. Source: OSTI; NTIS (US Sales Only); INIS.

In second quantization an m-particle and n-antiparticle state picks up the sum of geometric phases for each individual mode after parallel transport along a closed curve in parameter space. The transport of the vacuum implies in addition the occurrence of a Schwinger term. Depending on the transformation considered various relations between the two types of obstructions result. 6 refs. (Authors).

13687 (UWThPh-1990-39) **A super-version of quasi-free second quantization. 1. Charged particles.** Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik); Langmann, E. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 6 Nov 1990. 27p. Order Number DE91621762. Source: OSTI; NTIS (US Sales Only); INIS.

We present a formalism comprising and extending quasi-free second quantization of charged bosons and fermions. The second quantization of one-particle observables leads to current superalgebras and a super Schwinger term shows up. We introduce anticommuting parameters in order to construct super Bogoliubov transformations mixing bosons and fermion. As an application, we give representations of Lie superalgebras which are semidirect products of extensions of affine Kac-Moody algebras and the Virasoro algebra, and of the super Virasoro algebra. (Authors) 36 refs.

65 PHYSICS II

Refer also to citation(s) 13897

6510 Nuclear Physics

Refer also to citation(s) 13309, 13622, 13732, 13739, 13882

13688 (BNL-44207) **[Fundamental of hadron physics from the theoretical and the experimental points of view]: Foreign trip report, January 23, 1991-February 5, 1991.** Luccio, A. Brookhaven National Lab., Upton, NY (USA). 19 Feb 1991. 5p. Sponsored by USDOE,. DOE Contract AC02-76CH00016. Order Number DE91008844. Source: OSTI; NTIS; GPO Dep.

A winter course at a School of Nuclear Physics was organized by the Italian Government Agency INFN. Lectures included fundamental of Hadron Physics from the theoretical and the experimental points of view. The present traveler was invited to hold a course on relevant accelerator physics. All expenses were paid by the Italians.

13689 (DOE/ER/40321-7) **[Reaction mechanism studies of heavy ion induced nuclear reactions]: Annual progress report, [January 1990-January 1991].** Mignerey, A.C. Maryland Univ., College Park, MD (USA). Dept. of Chemistry and Biochemistry. Jan 1991. 45p. Sponsored by USDOE,. DOE Contract FG05-87ER40321. Order Number DE91008909. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following research projects; decay of excited nuclei formed in La-induced reactions at E/A = 45 MeV; mass and charge distributions in Cl-induced heavy ion reactions; and mass and charge distributions in ^{56}Fe + ^{165}Ho at E/A = 12 MeV.

13690 (DOE/ER/40361-1) **Nuclear spectroscopic studies: Progress report.** Bingham, C.R.; Guidry, M.W.; Riedinger, L.L.; Sorensen, S.P. Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy. 31 Jan 1988. 125p. Sponsored by USDOE,. DOE Contract FG05-87ER40361. Order Number DE91008434. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Physics group at the University of Tennessee, Knoxville is involved in several aspects of heavy-ion physics including both nuclear structure and reaction mechanisms. While our main emphasis is on experimental problems involving heavy-ion accelerators, we have maintained a strong collaboration with several theorists in order to best pursue the physics of our measurements. During the last year we have led experiments at the Holifield Heavy Ion Research Facility, the SuperHILAC at Berkeley, and Chalk River Tandem Accelerator. Also, we have joined a collaboration to study ultra-relativistic heavy ion physics and one of our group has spent all of 1987 at CERN to work on the WA80 experiment. Our experimental work is in four broad areas: (1) the structure of nuclei at high angular momentum, (2) heavy-ion induced transfer

reactions, (3) the structure of nuclei far from stability, and (4) ultra-relativistic heavy-ion physics. These results will be described in this document in sections 2A, 2B, 2C, and 2D, respectively. Areas (1), (3), and (4) concentrate on the structure of nuclear matter in extreme conditions of rotational motion, imbalance of neutrons and protons or very high temperature and density. Area (2) pursues the transfer of nucleons to states with high angular momentum, both to learn about their structure and to understand the transfer of particles, energy and angular momentum in collisions between heavy ions. An important component of our program is the strong emphasis on the theoretical aspects of nuclear structure and reactions.

13691 (DOE/ER/40361–4) **Nuclear spectroscopic studies: Progress report.** Bingham, C.R.; Guidry, M.W.; Riedinger, L.L.; Sorensen, S.P. Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy. 30 Jan 1991. 146p. Sponsored by USDOE,. DOE Contract FG05-87ER40361. Order Number DE91008553. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Physics group at the University of Tennessee, Knoxville is involved in several aspects of heavy-ion physics including both nuclear structure and reaction mechanisms. While our main emphasis is on experimental problems involving heavy-ion accelerators, we have maintained a strong collaboration with several theorists in order to best pursue the physics of our measurements. During the last year we have led experiments at the Holifield Heavy Ion Research Facility, the SuperHILAC at Berkeley, and Chalk River Tandem Accelerator. Also, we have joined a collaboration to study ultra-relativistic heavy ion physics and one of our group has spent all of 1987 at CERN to work on the WA80 experiment. Our experimental work is in four broad areas: (1) the structure of nuclei at high angular momentum, (2) heavy-ion induced transfer reactions, (3) the structure of nuclei far from stability, and (4) ultra-relativistic heavy-ion physics. These results will be described in this document in sections IIA, IIB, and IID, respectively. Areas (1), (3), and (4) concentrate on the structure of nuclear matter in extreme conditions of rotational motion, imbalance of neutrons and protons, or very high temperature and density. Area (2) pursues the transfer of nucleons to states with high angular momentum, both to learn about their structure and to understand the transfer of particles, energy and angular momentum in collisions between heavy ions. An important component of our program is the strong emphasis on the theoretical aspects of nuclear structure and reactions.

13692 (DOE/ER/40566–1) **Study of heavy ion interactions at 15 A GeV: Progress report, March 15, 1990–March 14, 1991.** Jain, P.L. State Univ. of New York, Buffalo, NY (USA). Dept. of Physics and Astronomy. 6 Dec 1990. 7p. Sponsored by USDOE,. DOE Contract FG02-90ER40566. Order Number DE91009137. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains brief discussions on studies of heavy ion interactions at 15 A GeV. (LSP)

13693 (INIS-XN–305) **Proceedings of the Seminar on NJOY and THEMIS.** Nuclear Energy Agency, 75 - Paris (France). 1989. 273p. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

Nuclear evaluated data processing codes are essential tools for the interpretation of basic data stored in files with formats reflecting the complex intrinsic structure of the data. They help users to filter out data and condense it to a form suitable to the physicist and engineer for nuclear application studies. The quality of evaluated data files can be determined by comparing their performance in predicting measured integral quantities. Evaluated data processing is an essential part in this benchmarking activity. Several tools have been developed over the years, but NJOY has taken up an eminent role because of its comprehensive set of features. NJOY and the French version THEMIS have been adopted as the standard processing codes for the JEF project. Considerable experience has been gained over the years from the different releases of NJOY and THEMIS. An important factor contributing to the improvements introduced has been the feedback provided by the users to the authors. The new format ENDF-6 adopted for the new evaluations led to a complete revision of NJOY which was recently released. It was therefore considered timely to organise a seminar in which the code developers and users could exchange information on: - the new features introduced in the most recent version - experience gained and validation of the different processing modules - maintenance, future developments and their co-ordination While a first workshop (1982) aimed at making NJOY known to the user community, the present seminar was aimed at experienced users. About thirty participants have attended the seminar and have contributed interesting presentations and lively discussions.

13694 (JAERI-M–90-198) **Multigroup cross sections of resonant nuclei considering moderator mass differences.** Okuno, Hiroshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Naito, Yoshitaka; Okuda, Yasuhisa. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 81p. (In Japanese). Order Number DE91755675. Source: OSTI; NTIS (US Sales Only); INIS.

The multigroup constants library MGCL in the nuclear criticality safety evaluation code system JACS has been produced by the Bondarenko method to treat self-shielding effects. For estimating errors of this treatment, the multigroup cross sections of MGCL are compared with those obtained by precise treatment, i.e. with the weighted cross sections by ultra-fine spectra of neutron. The precise calculations are made for homogeneous mixtures of a resonant nucleus (^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, ^{242}Pu or ^{56}Fe) and a fictitious moderator nucleus with mass number 1, 12 or 200. The ultra-fine spectrum is calculated by the RABBLE code. Distinct differences are found in the self-shielding factors by comparisons between both treatments. Moreover, as the mass number increases, depressions of the self-shielding factor at the resonance peaks and its enhancements at the window of resonances are observed. (author).

13695 (ORNL/TM–11763) **Generation of covariance files for the isotopes of Cr, Fe, Ni, Cu, and Pb in ENDF/B-VI.** Hetrick, D.M.; Larson, D.C.; Fu, C.Y. Oak Ridge National Lab., TN (USA). Feb 1991. 15p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (ENDF–350). Order Number DE91008631. Source: OSTI; NTIS; INIS; GPO Dep.

The considerations that governed the development of the uncertainty files for the isotopes of Cr, Fe, Ni, Cu, and Pb in ENDF/B-VI are summarized. Four different approaches were used in providing the covariance information. Some examples are given which show the standard deviations as a function of incident energy and the corresponding correlation matrices. 11 refs., 5 tabs.

6511 Experimental Techniques

Refer also to citation(s) 13775

13696 (LA-UR–91-514) **Hypernuclear spectroscopy with the (π,K) reaction.** Millener, J. (Brookhaven National Lab., Upton, NY (USA)); Johnson, M.B.; McGill, J. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9010264–9: Los Alamos Meson Physics Facility (LAMPF) workshop, Los Alamos, NM (USA), 11-13 Oct 1990). Order Number DE91008586. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. HYPERNUCLEI/pion reactions; HYPERNUCLEI; SPECTROSCOPY; SILICON 28 TARGET

6512 Nuclear Properties and Reactions, A = 1-5, Experimental

Refer also to citation(s) 13190, 13712

13697 (DOE/ER/40362–4) **Pion- and proton-nucleus interactions at intermediate energy: Progress report, June 1, 1990–May 31, 1991.** Dehnhard, D. Minnesota Univ., Minneapolis, MN (USA). Feb 1991. 36p. Sponsored by USDOE,. DOE Contract FG02-87ER40362. Order Number DE91009048. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the following topics: pion scattering from polarized ^{13}C; elastic scattering of π^+ and π^- from ^{4}He; the ^{4}He(π,π,t)p and ^{4}He(π,π,d) reactions; contributions to the planning of PILAC; and the ^{4}He(p,n)^{4}Li reaction at 100, 147, and 200 MeV.

13698 (INS-T–498, pp. 8-11) **Atomic collision using cooler rings: Electron capture.** Katayama, Ichiro (Osaka Univ., Ibaraki

(Japan). Research Center for Nuclear Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ELECTRON CAPTURE/ion beams; ELECTRON CAPTURE/storage rings; ION-ATOM COLLISIONS; CROSS SECTIONS; HELIUM IONS; HELIUM 3; ION CHANNELING; CRYSTALS; BEAM EXTRACTION

13699 (INS-T–498, pp. 12-16) **Atomic collision with high energy light ions: Ionization process.** Mukoyama, Takashi (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ION-ATOM COLLISIONS/ ionization; IONIZATION; DIFFERENTIAL CROSS SECTIONS; TOTAL CROSS SECTIONS; X RADIATION; AUGER ELECTRON SPECTROSCOPY; K SHELL; BORN APPROXIMATION; RELATIVITY THEORY

13700 (LA-UR–91-786) **Nuclear physics of the muon-catalyzed d+d reactions.** Hale, G.M. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9005313–2: 1990 conference on muon catalyzed fusion, Vienna (Austria), 28 May - 1 jun 1990). Order Number DE91009942. Source: OSTI; NTIS; GPO Dep.

A Coulomb-corrected, charge independent R-matrix calculation of the four-nucleon reactions accounts for the surprisingly large branching ratio, as well as for the absolute fusion rate measured for the muon- catalyzed d+d reactions. Reaction constants are given for both S-wave and P-wave transitions that would result in the sort of temperature dependence for the branching ratio that has recently been observed. 6 refs., 1 fig., 1 tab.

6513 Nuclear Properties and Reactions, A = 6-19, Experimental

Refer also to citation(s) 13636, 13697

13701 (GSI–90-27) **Elaboration of a model of the nuclear fragmentation and application to the method of isotopic separation of projectile fragments.** Gaimard, J.J. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.); Paris-7 Univ., 75 (France). Oct 1990. 143p. (In French). Order Number DE91756210. Source: OSTI; NTIS (US Sales Only); INIS.

In this thesis the experimental results on the cross sections for the production of ^{36}P in the fragmentation of 403 MeV/u ^{40}Ar on a carbon target are presented. Furthermore some models of the nuclear fragmentation are elaborated and compared by means of experimental data for the production of gold and cerium isotopes in the reaction ^{12}C+^{209}Bi at 400 MeV/u, of chlorine, sulfur, aluminium, magnesium, and oxygen isotopes in the reactions ^{40}Ar+^{12}C at 600 MeV/u and ^{48}Ca+^{9}Be at 212 MeV/u, and of cobalt, manganese, vanadium, and scandium isotopes together with the charge distributions for A=43 and A=44 in the reactions ^{40}Ar+^{64}Cu at 2 GeV/u and ^{56}Fe+^{12}C at 600 MeV/u. (HSI).

6514 Nuclear Properties and Reactions, A = 20-38, Experimental

Refer also to citation(s) 13707, 13712, 13759

13702 (INS-T–498, pp. 95-98) **Observation of nuclear spin polarization in projectile fragments, ^{39}Ca and ^{37}K, from 106 MeV/nucleon ^{40}Ca on ^{197}Au.** Matsuta, K. (Osaka Univ., Toyonaka (Japan). Dept. of Physics); Ozawa, A.; Nojiri, Y. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. CALCIUM 40 REACTIONS/ nuclear fragments; CALCIUM 40 REACTIONS/polarization-asymmetry ratio; GOLD 197 TARGET; GEV RANGE 01-10; CALCIUM 39; POTASSIUM 37; LINEAR MOMENTUM; BETA DECAY; ANGULAR DISTRIBUTION; EXPERIMENTAL DATA

13703 (LPCC–8907) **Light fragment emission correlated with large transverse momentum protons in 94 MeV/u ^{16}O induced reactions.** Durand, D. (Institut des Sciences de la Matiere du Rayonnement (ISMRA), 14 - Caen (FR)); Laville, J.L.; Bizard, G.; Bougault, R.; Genoux-Lubain, A.; Lefebvres, F.; Patry, J.P.; Badala, A.; Barbera, R.; Palmeri, A.; Pappalardo, G.S.; Schillaci, A.; Jin, G.MCaen Univ., 14 (France). Lab. de Physique Corpusculaire. 1989. 28p. Order Number DE91752696. Source: OSTI; NTIS (US Sales Only).

Angular, multiplicity and velocity distributions as well as azimuthal asymmetries of light fragments (Z=1 and 2) correlated with large transverse momentum protons detected at 90^0 have been measured in ^{16}O + ^{27}Al collisions at 94 MeV/u. Data are compared with a model based on the standard high energy fireball geometry coupled with the Weisskopf theory of evaporation. Reasonable agreement is achieved with the exception of some discrepancies which could arise either from the absence of specific intermediate energy corrections or from a non-statistical process.

13704 (LPCC–9003) **Global variables and impact parameter determination in nucleus-nucleus collisions below 100 MeV/u.** Peter, J. (Caen Univ., 14 (FR). Lab. de Physique Corpusculaire); Cussol, D.; Bizard, G.; Brou, R.; Louvel, M.; Patry, J.P.; Regimbart, R.; Steckmeyer, J.C.; Sullivan, J.P.; Tamain, B.; Crema, E.; Doubre, H.; Hagel, K.; Jin, G.M.; Peghaire, A.; Saint-LaurenCaen Univ., 14 (France). Lab. de Physique Corpusculaire. Mar 1990. 24p. Source: OSTI; NTIS (US Sales Only).

Several global variables are tested for determining the impact parameter in 4π measurements of charged products. For the system Ar+Al from 25 to 85 MeV/u, simulated reactions are used to study the correlation between the real impact parameter value and the experimentally determined one. Even with a perfect detector, the total multiplicity and the mid-rapidity charge give a poor correlation. Filtering through the acceptance of an actual detector (Mur+Tonneau at GANIL) provides a poor correlation with the total charge, and an acceptable one with the total perpendicular momentum. The average (mass weighted) parallel velocity V gives the best correlation and is less sensitive to the incident energy and to the mechanisms used in the simulation. Measurements extending to very forward angles are needed to accurately sort events by impact parameter. Real data are used to study the variation of other global variables versus V: they exhibit the expected average trend, with broad fluctuations. The excentricity and flow angle allow the evolution of central reactions with the incident energy to be followed. The proportion of relative motion transformed into energy perpendicular to the beam direction decreases when the incident energy increases; its absolute value, however, doubles from 25 to 65 MeV/u. In experimental studies where good separation between participant (pre-equilibrium) and spectator (equilibrium) particles is wanted in addition to good impact parameter sorting, the projectile mass should be in the range 1.2 - 2.5 times the target mass.

13705 (LPCC–9004) **Disappearance of flow as a function of impact parameter and energy in nucleus-nucleus collisions.** Sullivan, J.P. (and others); Peter, J.; Cussol, D.; Bizard, G.; Brou, R.; Louvel, M.; Patry, J.P.; Regimbart, R.; Steckmeyer, J.C.; Tamain, B.; Crema, E.; Doubre, H.; Hagel, K.; Jin, G.M.; Peghaire, A.; Saint-Laurent, F.; Motobayashi, T.; Cassagnou. Caen Univ., 14 (France). Lab. de Physique Corpusculaire. May 1990. 12p. Order Number DE91757087. Source: OSTI; NTIS (US Sales Only).

The dependence of collective nuclear flow on impact parameter and beam energy from 25 to 85 MeV/u has been measured for Ar + Al with the 4π array Mur + Tonneau. The flow of the particles emitted from the interaction region is attributed to scattering at negative angles. When the energy increases, compression gradually opposes this negative scattering, until the flow falls to zero. This is obtained at a beam energy in the range 70-80 MeV/u for impact parameters below 2 fm and increases with the impact parameter. This study as a function of the impact parameter and the

energy should allow information both on the nucleon-nucleon cross section in medium and the EOS of nuclear matter to be obtained.

6515 Nuclear Properties and Reactions, A = 39-58, Experimental

Refer also to citation(s) 13636, 13702, 13709

13706 (DOE/ER/40370–T3) **Electron distortion effects in quasi-elastic electron scattering.** Jin, Yanhe. Ohio Univ., Athens, OH (USA). Dept. of Physics and Astronomy. Mar 1991. 163p. Sponsored by USDOE,. DOE Contract FG02-87ER40370. Order Number DE91009034. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: dirac single particle shell model; dirac free states in Coulomb and optical potentials; deep inelastic electron scattering; plane wave born approximation and Rosenbluth separation; analysis of the $^{40}Ca(e,e')$ experimental data; and analysis of the exclusive $(e,e'p)$ experimental data.

13707 (GANIL-P–8902) **β-delayed neutron emission of the isotopes ^{20}C, $^{40,41,42}P$, $^{43,44}S$.** Lewitowicz, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Anne, R.; Detraz, C.; Guerreau, D.; Saint-Laurent, M.G.; Penionzhkevich, Yu.E.; Artukh, A.G.; Kalinin, A.M.; Kamanin, V.V.; Lukyanov, S.M.; Nguyen Hoai Chau,; Mueller, A.C.Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1989. 11p. Order Number DE91752690. Source: OSTI; NTIS (US Sales Only).

Very neutron-rich isotopes have been produced by the fragmentation of 55 MeV/u ^{48}Ca projectiles from GANIL onto a ^{181}Ta target. The nuclei were separated by means of the doubly achromatic spectrometer LISE and implanted into a semiconductor telescope for identification in Z and A. Their β-delayed neutron radioactivity is observed by means of a 4Π β coincidence detector. The results include first measurements of the half-life and the neutron emission probability P_n for the isotopes ^{20}C, $^{40,41,42}P$ and $^{43,44}S$. They are compared to current theoretical predictions.

13708 (GANIL-P–9013) **Search for direct two-proton radioactivity from Tl isotopes at the proton drip line.** Anne, R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Bricault, P.; Lewitowitcz, M.; Yu Hu Zhang; Detraz, C.; Guillemaud-Mueller, D.; Mueller, A.C.; Borrel, V.; Jacmart, J.C.; Pougheon, F.; Richard, A.; Bazin, D.; Dufour, J.P.; FleuGrand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 39p. Order Number DE91752698. Source: OSTI; NTIS (US Sales Only).

The neutron-deficient isotopes ^{39}Ti and ^{40}Ti have been produced as fragments of ^{58}Ni projectiles at 65 MeV per nucleon. Decay by β-delayed charged-particle emission has been observed for both of them with half lives of 26 ms for ^{39}Ti and 56 ms for ^{40}Ti. No evidence for direct two-proton emission from ^{39}Ti was obtained. The conditions that would make such a new radioactive mode possible are discussed.

6516 Nuclear Properties and Reactions, A = 59-89, Experimental

Refer also to citation(s) 12572

6517 Nuclear Properties and Reactions, A = 90-149, Experimental

Refer also to citation(s) 13711, 13713

13709 (INDC(CCP)–320/L, pp. 41-44) **Integral cross-sections for the reactions $^{51}V(n,\alpha)^{48}Sc$, $^{93}Nb(n,2n)^{92}Nb^m$ and $^{90}Zr(n,2n)^{89}Zr$.** Grigor'ev, E.I.; Melekhin, Yu.A.; Yaryna, V.P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987)*. 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

The mean reaction cross-sections for neutrons in the ^{235}U fission spectrum were measured for the reactions $^{51}V(n,\alpha)^{48}Sc$, $^{93}Nb(n,2n)^{92}Nb^m$ and $^{90}Zr(n,2n)^{89}Zr$. After their evaluation, the data have been compared with the calculated integral cross-sections from different libraries. 13 refs, 4 tabs.

13710 (LPCC–8901) **Transfer reactions and sequential decays of the projectile like fragments in the 60 MeV/nucleon $^{40}Ar+^{nat}Ag$, ^{197}Au reactions.** Steckmeyer, J.C. (Institut des Sciences de la Matiere du Rayonnement (ISMRA), 14 - Caen (FR)); Bizard, G.; Brou, R.; Eudes, P.; Laville, J.L.; Natowitz, J.B.; Patry, J.P.; Tamain, B.; Thiphagne, A.; Doubre, H.; Peghaire, A.; Peter, J.; Rosato, E.; Adloff,.Caen Univ., 14 (France). Lab. de Physique Corpusculaire. Jan 1989. 41p. Order Number DE91752693. Source: OSTI; NTIS (US Sales Only).

Light charged particles and nuclei ($1 \leq Z \leq 8$) have been detected in a large forward plastic multidetector ($3^0 < \theta < 30^0$) in coincidence with projectile-like fragments ($5 \leq Z \leq 19$) in the $^{40}Ar+^{nat}Ag$ and $^{40}Ar+^{197}Au$ reactions at 60 MeV/nucleon bombarding energy. It is shown that transfer reactions from the projectile to the target are still present at such a high incident energy. Most of the coincident Z=2 particles are found to be sequentially emitted by excited primary projectile-like fragments. The sequential decay pattern is also observed with the Z=1 particles, but the main part of those particles probably arise from other mechanisms such as direct and/or pre-equilibrium emission. An attempt is made to derive the excitation energies of the primary projectile-like fragments from these coincident events. The data are not reproduced by the usual models such as the high energy abrasion model, the equal temperature limit assumption or the equal partition of the excitation energy.

6518 Nuclear Properties and Reactions, A = 150-189, Experimental

13711 (CONF-9009135–9) **High spin lifetimes in ^{161}Lu.** Yu, C.H. (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy); Jin, H.Q.; Lewis, J.; Pilotte, S.; Riedinger, L.L.; McGowan, F.K.; Lee, I.Y.; Garrett, J.D.; Johnson, N.R.; Gao, W.B.; Xie, H.; Wells, J.C. Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy. [1990]. 13p. Sponsored by USDOE,. DOE Contract FG05-87ER40361 ;AC05-84OR21400. From International conference on high spin physics and gamma-soft nuclei; Pittsburgh, PA (USA); 17-21 Sep 1990. Order Number DE91008610. Source: OSTI; NTIS; INIS; GPO Dep.

Lifetimes of high spin states in the yrast decay sequence of ^{161}Lu are measured with the DSAM technique, using the $^{120}Sn(^{45}Sc,4n)^{161}Lu$ reaction at a beam energy of 205 MeV. The results are compared to the existing data of other N = 90 isotones. Such a comparison shows that $^{161}Lu_{90}$ has a 20% smaller B(E2) than those for $^{157}Ho_{90}$, the only other odd-Z, N = 90 isotone for which high spin lifetime data exist. Part of the difference in B(M1)/B(E2) ratios between these two nuclei is therefore attributed to that in the B(E2) values. The remaining difference is most likely related to a larger B(M1) value in ^{161}Lu associate with a larger neutron alignment. 25 refs., 7 figs.

6519 Nuclear Properties and Reactions, A = 190-219, Experimental

Refer also to citation(s) 13710

13712 (BNL–45852) **A review of recent E802 results.** Kaufman, S. (Argonne National Lab., IL (USA)); Videbaek, F.; Beavis, D.; Bond, P.D.; Chasman, C.; Chen, Z.; Chu, Y.Y.; Cumming, J.B.; Debbe, R.; Gushue, S.; Hansen, O.; Katcoff, S.; Levine, M.J.; Miake, Y.; Moskowitz, B.; Olness, J.; Remsberg, L.P.; Shor,.E802 Collaboration. Brookhaven National Lab., Upton, NY (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016 ;W-7405-ENG-48 ;W-31109-ENG-38. (CONF-910135–1: 7. winter workshop on nuclear dynamics, Key West, FL (USA), 27 Jan - 2 feb 1991). Order Number DE91009447. Source: OSTI; NTIS; INIS; GPO Dep.

Some recent results are presented from AGS E802, a survey experiment which is studying reactions of 14.6 A · GeV beams of

protons, ^{16}O and ^{28}Si on targets ranging from ^{9}Be to ^{197}Au. Spectra for the global forward and transverse energy are shown; in nucleus-nucleus collisions these two quantities are anticorrelated, consistent with a large amount of stopping. Slope parameters from inclusive particle spectra are presented, with the most interesting effect being an apparent "heating" of mid-rapidity protons which emerge from the collisions of the largest nuclei. Also given are preliminary data on the production of antiprotons. 8 refs., 4 figs., 1 tab.

13713 (GANIL-P–9016) **Energy dissipation in peripheral reactions induced by ^{40}Ar beams between 27 and 44 MeV/u.** Morjean, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Doubre, H.; Galin, J.; Guerreau, D.; Pouthas, J.; Jiang, D.X.; Frehaut, J.; Patin, Y.; Pranal, Y.; Charvet, J.L.; Magnago, C.; Lott, B. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 38p. Order Number DE91752743. Source: OSTI; NTIS (US Sales Only).

Projectile-like fragments have been measured in ^{40}Ar induced reactions on ^{197}Au at 27,35 and 44 MeV/u and on ^{103}Rh at 27 MeV/u. The excitation energies deposited in the associated target-like fragments have been estimated from multiplicities of coincident neutrons measured with a 4π detector. The angular and energy distributions of the projectile-like fragments can be understood in terms of a damped process. The energy dissipation can be understood by assuming a non-equilibrium emission or abrasion of nucleons from the system. For the lightest detected fragments, the occurrence of yet other mechanisms cannot be excluded.

13714 (GANIL-P–9018) **Exclusive study of the formation and the decay of hot nuclei in the intermediate energy domain.** Saint-Laurent, F. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 11p. (CONF-9010299–: International symposium on heavy ion physics and its applications, Lanzhou (China), 7-13 Oct 1990). Order Number DE91757088. Source: OSTI; NTIS (US Sales Only).

A brief review of exclusive measurements performed at GANIL in order to study hot nuclei will be given. Heavy-ion induced reactions on heavy targets have been investigated over a wide range of incident energy, using various techniques: - fission fragment angular correlations. - 4 π neutron multiplicity measurements. - light charged particle correlations. In each case, a selection of the most violent collisions can be achieved. For central collisions induced by ^{40}Ar, a same excitation energy of about 650 MeV is deduced from the totally different and independent sets of data, corresponding to an average temperature of 5 MeV. At 60 MeV/u, this value is quite low as compare to the total available energy for central collisions A tentative explanation based on Landau-Vlasov simulations will be proposed: the excitation energy dissipated in the system could be stored in a highly excited compression mode as well as under a thermal form. Some recent results on the Kr+Au system at 32 MeV/u will be presented indicating that heavier projectiles than ^{40}Ar can lead to a temperature of the hot system approaching 7 MeV.

13715 (GANIL-T–9001) **The formation and deexcitation of hot nuclei in ^{40}Ar + ^{197}Au collisions at 44 and 77 MeV/A. Neutrons emission light charged particles and complex fragments.** Sokolov, A. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France); Paris-6 Univ., 75 (France). May 1990. 134p. (In French). Order Number DE91757083. Source: OSTI; NTIS (US Sales Only).

This work is a contribution to the study of the formation and decay of hot nuclei produced in heavy ion collisions at intermediate energies. By studying the system Ar + Au and Ar + Th at 44 MeV/u and 77 MeV/u we first show how to classify events in two groups: peripheral and very dissipative collisions, measuring the number of evaporated neutrons, which depend directly on the violence of the collision. Associated with these neutrons, different deexcitation channels were observed (heavy residues, fission fragments, light charged particles, intermediate mass fragments). The ratio between peripheral and very dissipative collisions was found independent of the system and the same as the one observed at lower incident energy. The most probable neutron multiplicity for very dissipative collisions is not very different at 44 MeV/u and 77 MeV/u. A measurement of the angular distribution of fission fragments and heavy residues was performed. Detected products are essentially associated with large neutron multiplicity and have a cross section close to the one for the very dissipative collisions. The total mass of the fission fragments is close to the mass of the target, while the mass of the heavy residue is much smaller. The backward evaporated light charged particles are also produced in very dissipative collisions. The characteristics of their energy spectra as well as their multiplicities are very similar at 44 MeV/u 77 MeV/u. From the number of evaporated light charged particles, the estimation of the quasi-target excitation energy was done and found to be close to 600 MeV at 44 MeV/u and 77 MeV/u.

13716 (LBL–29578-Rev.) **Proton rapidity distributions from 60 GeV/n ^{16}O + Au collisions.** Tonse, S. Lawrence Berkeley Lab., CA (USA). May 1990. 5p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-900570–15-Rev.: 8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90, Menton (France), 7-11 May 1990). Order Number DE91009087. Source: OSTI; NTIS; INIS; GPO Dep.

An analysis of the proton rapidity distribution in central ^{16} O + Au collisions at 60 GeV/n measured in the NA35 streamer chamber detector at the CERN SPS is presented. The charge excess of positive particles over negative particles was measured. The rapidity distribution of the charge excess which can be associated with the primordial protons in the collision is studies in terms of the nuclear stopping power and is compared to the predictions of various models. 7 refs., 2 figs.

13717 (LBL–29793) **Heavy residue properties in intermediate energy nuclear collisions with gold.** Aleklett, K. (Uppsala Univ., Nykoeping (Sweden). Studsvik Neutron Research Lab.); Sihver, L.; Loveland, W.; Liljenzin, J.O.; Seaborg, G.T. Lawrence Berkeley Lab., CA (USA). Oct 1990. 13p. Sponsored by USDOE, Washington, DC (USA); Swedish National Science Research Council (Sweden). DOE Contract AC03-76SF00098 ;FG06-88ER40402. (CONF-9010299–3: International symposium on heavy ion physics and its applications, Lanzhou (China), 7-13 Oct 1990). Order Number DE91009072. Source: OSTI; NTIS; INIS; GPO Dep.

We have measured the target fragment production cross sections and angular distributions for the interaction of 32, 44 and 93 MeV/nucleon argon, 35 and 43 MeV/nucleon krypton with gold. The fragment isobaric yield distributions, moving frame angular distributions and velocities have been deduced from these data. This fission cross section decreases with increasing projectile energy and the heavy residue cross section increases. The ratio $v_{||}/v_{cn}$ increases approximately linearly with mass removed from the target. 21 refs., 8 figs.

13718 (LPCC–8903) **Nuclear matter flow in the Kr+Au collisions at 43 MeV/u.** Bougault, R. (Institut des Sciences de la Matiere du Rayonnement (ISMRA), 14 - Caen (FR)); Delaunay, F.; Genoux-Lubain, A.; Lebrun, C.; Lecolley, J.F.; Lefebvres, F.; Louvel, M.; Steckmeyer, J.C.; Aloff, J.C.; Bilwes, B.; Bilwes, R.; Glaser, M.; Rudolf, G.Caen Univ., 14 (France). Lab. de Physique Corpusculaire. 1989. 15p. (CONF-8904153–: Symposium on nuclear dynamics and nuclear disassembly, Dallas, TX (USA), 9-14 Apr 1989). Order Number DE91752694. Source: OSTI; NTIS (US Sales Only).

When heavy nuclei collide at energy far above the Coulomb barrier we may study the property of nuclear matter in temperature and also density regions far away from the equilibrium. We then hope to study dynamical effects related to the compressibility and the two body collision term. At relativistic energies, some collective effects (flow, bounce off) have been established from a shape analysis done with a large number of light particles with $Z \leq 10$. For incident energies lower than 100 MeV/u we may expect that the number of nuclear species formed will be smaller and that a large part of the nuclear matter involved in the collision will be shared in a limited number of heavy fragments ($Z \geq 10$). If dynamical effects are still present at GANIL energies they ought to manifest themselves through the properties of the produced fragments (masses, emission angles, velocities and correlated variables). We will present an analysis of heavy nuclei collisions at 43 MeV/u based on as exclusive as possible detection of large fragments.

13719 (LPCC–8904) **Time scale analysis of events with three heavy fragments in the ^{22}Ne + Au collisions at 60 MeV/u.** Bougault, R. (Institut des Sciences de la Matiere du Rayonnement

(ISMRA), 14 - Caen (FR)); Colin, J.; Delaunay, F.; Genoux-Lubain, A.; Hajfani, A.; Lebrun, C.; Lecolley, J.F.; Louvel, M.; Steckmeyer, J.C. Caen Univ., 14 (France). Lab. de Physique Corpusculaire. May 1989. 10p. Order Number DE91752695. Source: OSTI; NTIS (US Sales Only).

Experimental results on the production of 2 or 3 heavy ($Z \geq 10$) fragments in the $^{22}Ne+Au$ collisions at 60 MeV/u are presented; the 3 fragment requirement selects large linear momentum transfer (70%) and large excitation energy (3 to 5 MeV/u.m.a.) for the incomplete fusion system. An analysis of the relative velocities and angles in the centre of mass of the 3 fragments shows that a sequential process with short time span and mutual influence between the two binary decays is favoured. A confirmation is found in the comparison of the correlation functions V_{ij} and Θ_{ij} with the results of Coulomb trajectories calculations including various time scales.

13720 (LPCC–9001) **Multi-fragment events in the AR + AU system at 30 and 60 MeV/u.** Delagrange, H. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Doubre, H.; Jin, G.; Kato, S.; Peghaire, A.; Saint-Laurent, F.; El Masri, Y.; Fugiwara, H.; Jeong, S.C.; Kugo, H.; Lee, S.M.; Matsuse, T.; Yamaha, T.; Motobayash, T.; BadalCaen Univ., 14 (France). Lab. de Physique Corpusculaire. 1990. 13p. (CONF-9001120–: International winter meeting on nuclear physics, Bormio (Italy), 22-26 Jan 1990). Order Number DE91752691. Source: OSTI; NTIS (US Sales Only).

Some results concerning the production of multi-fragment events detected in the reaction Ar + Au at 30 and 60 MeV/u are presented. After a discussion of the main trends of the data, a kinematical analysis testing the completeness of the events is presented. It shows the emergence of a three-body decay channel as an alternative to standard fission for an average excitation energy estimated at 3 MeV/u.

13721 (LPCC–9002) **Sidewards flow effect in Kr + Au central collisions at 43 MeV/u.** Bougault, R. (Institut des Sciences de la Matiere du Rayonnement (ISMRA), 14 - Caen (FR)); Delaunay, F.; Genoux-Lubain, A.; Le Brun, C.; Lecolley, J.F.; Lefebvres, F.; Louvel, M.; Steckmeyer, J.C.; Adloff, J.C.; Bilwes, B.; Bilwes, R.; Glaser, M.; Rudolf,.Caen Univ., 14 (France). Lab. de Physique Corpusculaire. 1990. 33p. (CONF-9001120–: International winter meeting on nuclear physics, Bormio (Italy), 22-26 Jan 1990). Order Number DE91752692. Source: OSTI; NTIS (US Sales Only).

When heavy nuclei collide at an energy far above the Coulomb barrier we may study the propertie of nuclear matter in temperature and density regions far away from equilibrium. We then hope to study dynamical effects related to the compressibility and the collision term. At relativistic energies, collective effects (flow, bounce off) have been established from a shape analysis done with a large number of light particles. For incident energies lower than 100 MeV/A we may expect that the number of nuclear species formed will be smaller and that a large part of the nuclear matter involved in the collision will be shared in a limited number of heavy fragments. If dynamical effects are present at GANIL energies they ought to manifest themselves through the properties of the produced fragments (masses, emission angles, velocities and correlated variables). We will present an analysis of heavy ion collisions at 43 MeV/A based on as exclusive as possible detection of large fragments.

6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

Refer also to citation(s) 13194, 13714, 13735, 13740

13722 (INDC(CCP)–320/L, pp. 5-16) **Analysis of ^{235}U neutron cross-sections in the fast neutron energy region.** Klepatskij, A.B.; Kon'shin, V.A.; Maslov, V.M.; Sukhovitskij, E.Sh. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987).* 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

The present work focuses on the specific aspects of evaluating neutron data in the fast neutron energy region. Emphasis is placed on the evaluation of those types of cross-sections for which few experimental data are available or where the data are contradictory. 20 refs, 9 figs.

13723 (JAERI-M–90-197) **BASIC programs for calculation of sensitivities and uncertainties of fission product decay heat.** Iijima, Shungo (Toshiba Corp., Kawasaki, Kanagawa (Japan). Nuclear Engineering Lab.); Katakura, Jun-ichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 95p. (In Japanese). Order Number DE91755670. Source: OSTI; NTIS (US Sales Only); INIS.

BASIC programs SENSFP, DHCOV and COVEDIT for microcomputer were developed for calculating the sensitivities and uncertainties of fission-product decay heat by summation method. The decay and yield data were adopted from JNDC Version-2 fission product nuclear data library, and their uncertainties were newly evaluated. The decay chains adopted in the calculation were simplified to some extent, but the validity was confirmed. SENSFP calculates the sensitivity coefficients to decay data and fission yield data analytically. The code treats the mass ranges of A = 83-110 and 125-153 for burst and infinite irradiations of U-235, U-238 and Pu-239. In program DHCOV, the standard deviations of decay heats for each mass chain are calculated using the sensitivity coefficients and the parameter uncertainty data. The COVEDIT code edits the masswise and total standard deviations of decay heat. Correlations among parameter uncertainties are discussed, but not incorporated into the program. Method of sensitivity and uncertainty analyses are described. The program structure, operational procedure and input/output data forms are presented. In Appendices are given the adopted decay chains, examples of calculation and the program lists. The codes were used to evaluate the uncertainties of the recommended decay heat by the Research Committee on Decay Heat Standard, Japan Atomic Energy Society, 1990. (author).

6530 Nuclear Theory

Refer also to citation(s) 13656, 13659, 13688, 13690, 13691, 13695, 13701, 13706

13724 (AEEW-R–2591) **NEACRP thermal fission product benchmark.** Halsall, M.J.; Taubman, C.J. UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div. Sep 1989. 91p. (NEACRP-A–995.). Order Number DE91622188. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of the thermal fission product benchmark was to compare the range of fission product data in use at the present time. A simple homogeneous problem was set with 200 atoms H/1 atom U235, to be burnt up to 1000 days and then decay for 1000 days. The problem was repeated with 200 atoms H/1 atom Pu239, 20 atoms H/1 atom U235 and 20 atoms H/1 atom Pu239. There were ten participants and the submissions received are detailed in this report. (author).

13725 (BNL–45200) **Evaluation at the medium energy region for Pb-208 and Bi-209.** Fukahori, Tokio; Pearlstein, S. Brookhaven National Lab., Upton, NY (USA). [1991]. 80p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910503–1: International conference on nuclear data for science and technology, Juelich (Germany, F.R.), 13-17 May 1991). Order Number DE91001111. Source: OSTI; NTIS; INIS; GPO Dep.

Medium energy nuclear data in the 1–1000 MeV range is necessary to accelerator applications which include spallation neutron sources for radioactive waste treatment and accelerator shielding design, medical applications which include isotopes production and radiation therapy, and space applications. For the design of fission and fusion reactors, the nuclear data file for neutrons below 20 MeV is available and well evaluated. Evaluated nuclear data for protons and data in the medium energy region, however, have not been prepared completely. Evaluation in the medium energy region was performed using the theoretical calculation code ALICE-P or experimental data. In this paper, the evaluation of neutron and

proton induced nuclear data for Pb-208 and Bi-209 has been performed using ALICE-P, empirical calculations and new systematics for the fission cross section. The evaluated data are compiled for possible inclusion in the ENDF/B-VI High Energy File. 204 refs., 51 figs., 9 tabs.

13726 (BONN-IR-90-52) **Elastic neutron-deuteron scattering with W-matrix formulation of the 2-particle input for the Paris potential.** Januschke, T. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Nov 1990. 107p. (In German). Order Number DE91756619. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron-deuteron scattering calculations are performed for the Paris potential using the W-matrix representation of the two-body T-matrix. In comparison with experimental and theoretical data the results demonstrate the high quality of the W-matrix approach even for realistic nucleon-nucleon interactions. (orig.).

13727 (BONN-IR-90-54) **The W-matrix method in the three-nucleon problem: QBA calculations with unapproximated residual term and formulation of a 3-particle W-matrix.** Kerwath, U. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Nov 1990. 113p. (In German). Order Number DE91756620. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron-deuteron scattering and boundstate calculations are performed comparing two different ways of improving the results obtained by the rank-one W-matrix formalism. These are the Quasi-Born-Approximation taking into account the complete remainder of the two body T-matrix and the method of choosing an optimal parameter k for the W-matrices. Additionally, a three body W-matrix is constructed and tested for the boundstate problem. (orig.).

13728 (CONF-9005238–4) **Superdeformations and fermion dynamical symmetries.** Wu, Cheng-Li (Drexel Univ., Philadelphia, PA (USA). Dept. of Physics and Atmospheric Science). Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy. [1990]. 31p. Sponsored by USDOE,. DOE Contract FG05-87ER40361 ;AS05-76ER04936. From Symposium in honor of Akito Arima: nuclear physics in the 1990's: Santa Fe, NM (USA); 1-5 May 1990. Order Number DE91008609. Source: OSTI; NTIS; INIS; GPO Dep.

In this talk, I will present a link between nuclear collective motions and their underlying fermion dynamical symmetries. In particular, I will focus on the microscopic understanding of deformations. It is shown that the SU_3 of the one major shell fermion dynamical symmetry model (FDSM) is responsible for the physics of low and high spins in normal deformation. For the recently observed phenomena of superdeformation, the physics of the problem dictates a generalization to a supershell structure (SFDSM), which also has an SU_3 fermion dynamical symmetry. Many recently discovered feature of superdeformation are found to be inherent in such an SU_3 symmetry. In both cases the dynamical Pauli effect plays a vital role. A particularly noteworthy discovery from this model is that the superdeformed ground band is not the usual unaligned band but the D-pair aligned (DPA) band, which sharply crosses the excited bands. The existence of such DPA band is a key point to understand many properties of superdeformation. Our studies also poses new experimental challenge. This is particularly interesting since there are now plans to build new and exciting γ-ray detecting systems, like the GAMMASPHERE, which could provide answers to some of these challenges. 34 refs., 11 figs., 5 tabs.

13729 (DOE/ER/40286–T3) **Configuration space Faddeev calculations: Progress report, January 1, 1990–December 31, 1990.** Payne, G.L.; Klink, W.H.; Ployzou, W.N. Iowa Univ., Iowa City, IA (USA). Dept. of Physics and Astronomy. Jan 1991. 27p. Sponsored by USDOE,. DOE Contract FG02-86ER40286. Order Number DE91008517. Source: OSTI; NTIS; INIS; GPO Dep.

The detailed study of few-body systems provides one of the most precise tools for studying the dynamics of nuclei. Our research program consists of a careful theoretical study of the nuclear few-body systems. During the past year we have completed several aspects of this program. We have continued our program of using the trinucleon system to investigate the validity of various realistic nucleon-nucleon potentials. Also, the effects of meson-exchange currents in nuclear systems have been studied. Initial calculations using the configuration-space Faddeev equations for nucleon-deuteron scattering have been completed. With modifications to treat relativistic systems, few-body methods can be applied to phenomena that are sensitive to the structure of the individual hadrons. We have completed a review of Relativistic Hamiltonian Dynamics in Nuclear and Particle Physics for Advances in Nuclear Physics. Although it is called a review, it is a large document that contains a significant amount of new research.

13730 (DOE/ER/40370–3) **Theory of photon and electron induced reactions: Progress report, July 1, 1990–June 30, 1991.** Onley, D.S.; Wright, L.E. Ohio Univ., Athens, OH (USA). Dept. of Physics and Astronomy. Feb 1991. 8p. Sponsored by USDOE,. DOE Contract FG02-87ER40370. Order Number DE91008993. Source: OSTI; NTIS; INIS; GPO Dep.

During the first seven months of our new grant from the Department of Energy we have made considerable progress on the following aspects of the general investigation of electron and photon induced reactions: (a) photo- and electroproduction of measons; (b) Coulomb distortion effects on (e,e'γ) and (e,e'p); and (c) studies involving the relativistic shell model. We will report on each of these developments in this paper.

13731 (GSI–90-67(prepr.)) **Linearised collective Schroedinger equation for nuclear quadrupole surface vibrations.** Greiner, M. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Heumann, D.; Scheid, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Nov 1990. 17p. (CONF-9008152–: Predeal international summer school on recent advances in nuclear structure, Predeal (Romania), 28 Aug - 8 sep 1990). Order Number DE91756665. Source: OSTI; NTIS (US Sales Only); INIS.

The linearisation of the Schroedinger equation for nuclear quadrupole surface vibrations yields a new spin degree of freedom, which is called collective spin and has a value of 3/2. With the introduction of collective spin dependent potentials, this linearised Schroedinger equation is then used for the description of low energy spectra and electromagnetic transition probabilities of some even-odd Xe, Ir and Au nuclei which have a spin 3/2 in their groundstate. (orig.).

13732 (INDC(CCP)–320/L, pp. 25-39) **Systematics of radiation widths and level density parameters in the mass number range region $40<A<250$.** Bychkov, V.M.; Grudzevich, O.T.; Plyaskin, V.I. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987).* 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

We suggest a systematics of radiation width based on a reduced radiative capture strength function for the E1-transition, which eliminates fluctuations in the analysed quantity with neutron binding energy, nuclear level density and γ-quanta energy. A smooth dependence for the fitting parameter of the radiative strength function for E1-transitions in relation to the relative atomic mass of the nucleus is obtained. 10 refs, 2 figs.

13733 (INDC(CCP)–320/L, pp. 17-23) **Energy distributions of secondary neutrons for ^{235}U.** Kon'shin, V.A.; Porodzinskij, Yu.V.; Sukhovitskij, E.Sh. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987).* 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

In order to calculate the energy dependences of secondary neutrons in specific neutron reactions on ^{235}U, a model was developed which makes no allowance for dependence on J, but does permit

the neutron spectra for these reactions to be obtained. 7 refs, 4 figs, 1 tab.

13734 (INDC(CCP)–320/L, pp. 45-54) **Approximation of the cross-sections for charged-particle emission reactions near the threshold.** Badikov, S.A.; Pashchenko, A.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987).* 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

We perform an analytical approximation of the energy dependence of the cross-sections for the reactions (n,p) and (n,γ) from the BOSPOR library, correct them for the latest differential and integral experimental data using the common features, characteristic of the energy dependence of the threshold reaction cross-section and making some physical assumptions. 19 refs, 1 fig., 1 tab.

13735 (INDC(CCP)–320/L, pp. 55-64) **Group constants for ^{233}U, ^{235}U and ^{239}Pu in the resonance region.** Van'kov, A.A.; Kolesov, V.V.; Ukraintsev, V.F. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1987).* 64p. Order Number DE91622181. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-279/G.

We give the results of group constant calculations for three fissile nuclides (^{233}U, ^{235}U, ^{235}Pu) obtained by the method of joint analysis of neutron cross-sections and transmission functions in a multilevel model. 13 refs, 5 tabs.

13736 (INS-T–498, pp. 99-103) **Nuclear physics and spin polarized unstable nuclear beams.** Minamisono, Tadanori (Osaka Univ., Toyonaka (Japan). Faculty of Science). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

A new field, i.e., a huge part of new nuclear physics, can be efficiently opened up and be developed using those unstable nuclei that belong to high isospin families. Since those families will be produced most efficiently through nuclear reactions initiated with incident beams of the energy about 300 MeV/nucleon, the TARN II, or an accelerator equivalent to this, is urgently needed. Because of the high kinetic energy obtained in the reaction, it is easy to have them penetrate tilted foils to polarize in their nuclear spins, and to implant them in suitable stopping materials to keep them in a well defined place, which conditions are imperative for many experimental studies. Therefore, it is clear that, after the completion of the required tests and studies of the TARN II, this machine can be efficiently used for the above mentioned studies and the trainings of the young heavy-ion physicists. Such changes and enhancements of the original purposes of TARN II to those above mentioned are very important, and they are quite natural for our nuclear physics society, because, until the completion of the Exotic Nuclei Arenain the JAPAN HADRON PROJECT, physicists who have something to do with can play their physics to some extent to keep up their abilities and also to continue the education of the students in the nuclear physics society. (author).

13737 (Juel–2396) **Production of strangeness on nuclei at energies near threshold.** Kopeliovich, B. (Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Kernphysik); Nemchik, J. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Kernphysik. Oct 1990. 16p. Order Number DE91756673. Source: OSTI; NTIS (US Sales Only); INIS.

New calculations of K^+ subthreshold production on nuclei with double-step mechanism are performed, taking into account binding energy of nucleons. As the result cross section is lowed down by an order of magnitude. Production of an intermediate pion in the reaction $pN \rightarrow \pi d$ is found to be of great importance. It is shown that at energies deep under the threshold the double-step mechanism essentially involves a high-momentum part of the Fermi-motion, what brings about considerable uncertainties due to both poor knowledge of the edge of the Fermi-spectrum and relativistic effects. (orig.).

13738 (LA-UR–91-437) **Theoretical descriptions of neutron emission in fission.** Madland, D.G. Los Alamos National Lab., NM (USA). [1990]. 37p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9010324–1: International Atomic Energy Agency (IAEA) consultants meeting on nuclear emission in the fission process, Vienna (Austria), 22-24 Oct 1990). Order Number DE91008580. Source: OSTI; NTIS; INIS; GPO Dep.

Brief descriptions are given of the observables in neutron emission in fission together with early theoretical representations of two of these observables, namely, the prompt fission neutron spectrum N(E) and the average prompt neutron multiplicity $\bar{\nu}_p$. This is followed by summaries, together with examples, of modern approaches to the calculation of these two quantities. Here, emphasis is placed upon the predictability and accuracy of the new approaches. In particular, the dependencies of N(E) and $\bar{\nu}_p$ upon the fissioning nucleus and its excitation energy are discussed. Then, recent work in multiple-chance fission and other recent work involving new measurements are presented and discussed. Following this, some properties of fission fragments are mentioned that must be better known and better understood in order to calculate N(E) and $\bar{\nu}_p$ with higher accuracy than is currently possible. In conclusion, some measurements are recommended for the purpose of benchmarking simultaneous calculations of neutron emission and gamma emission in fission. 32 refs., 26 figs.

13739 (LBL–30129) **Review of CERN heavy-ion physics.** Harris, J.W. Lawrence Berkeley Lab., CA (USA). Dec 1990. 25p. Sponsored by USDOE,. DOE Contract AC03-76SF00098. (CONF-9009339–2: International workshop on high density nuclear matter, Ibaraki (Japan), 18-21 Sep 1990). Order Number DE91009326. Source: OSTI; NTIS; INIS; GPO Dep.

The primary motivation for studying nucleus-nucleus collisions at very high energies is the possibility of forming a quark-gluon plasma (QGP). In these collisions energy and baryon densities are expected to increase and reach critical values where the quark constituents of the incident nucleons, bound in nuclei, form an extended volume of freely interacting quarks, antiquarks and gluons. Various signatures of the existence of a quark-gluon plasma in these collisions have been proposed: suppression of J/Psi production, an enhancement in strange particle production, event-by-event fluctuations in the rapidity distributions of produced particles, observation of direct photons from the plasma and other observables. The system is expected to evolve dynamically from a pure plasma or mixed phase through expansion, cooling, hadronization and freeze-out. To be able to determine that a new, transient state of matter has been formed it is necessary not only to identify QGP signatures but also to determine the space-time evolution of the collision process. This requires an understanding of the microscopic structure of hadronic interactions, at the level of quarks and gluons, at high temperatures and high densities. In this talk I will describe the physical observables important for understanding the dynamics of heavy-ion collisions at high energies and the present status of experimental results covering these observables. I will then describe the various signatures of QGP formation, present experimental results and plausible interpretations of the results. This talk is not meant to be a comprehensive review, it is rather a summary of important background information, current outstanding problems, observations of particular interest and recent results on dynamics and signatures.

6540 Radiation and Shielding Physics

Refer also to citation(s) 12796, 13321, 13526, 13783

13740 (INDC(CCP)–322/L) **Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1988).** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. 19p. Translated by the IAEA.

Original report in Russian was distributed as INDC(CCP)-310/G. Order Number DE91623087. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-310/G.

The document contains the English translation of the following two papers published in Yadernye Konstanty 3, 1988: "Measurement and analysis of neutron transmission and self-indication of the neutron radiative capture cross-section for ^{238}U in the 5-110 keV energy region" and "Re-evaluation of the resonance parameters of ^{241}Pu. Refs, figs and tabs.

13741 (ORNL/TR–90/28) **Investigation of 1-cm dose equivalent for photons behind shielding materials.** Hirayama, Hideo (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Tanaka, Shun-ichi. Oak Ridge National Lab., TN (USA). Mar 1991. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91008916. Source: OSTI; NTIS; INIS; GPO Dep.

The ambient dose equivalent at 1-cm depth, assumed equivalent to the 1-cm dose equivalent in practical dose estimations behind shielding slabs of water, concrete, iron or lead for normally incident photons having various energies was calculated by using conversion factors for a slab phantom. It was compared with the 1-cm depth dose calculated with the Monte Carlo code EGS4. It was concluded from this comparison that the ambient dose equivalent calculated by using the conversion factors for the ICRU sphere could be used for the evaluation of the 1-cm dose equivalent for the sphere phantom within 20% errors. Average and practical conversion factors are defined as the conversion factors from exposure to ambient dose equivalent in a finite slab or an infinite one, respectively. They were calculated with EGS4 and the discrete ordinates code PALLAS. The exposure calculated with simple estimation procedures such as point kernel methods can be easily converted to ambient dose equivalent by using these conversion factors. The maximum value between 1 and 30 mfp can be adopted as the conversion factor which depends only on material and incident photon energy. This gives the ambient dose equivalent on the safe side. 13 refs., 7 figs., 2 tabs.

13742 (SAND–90-2437C) **Stability analysis of time-dependent transport algorithms.** Badruzzaman, A. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910414–25: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91009170. Source: OSTI; NTIS; GPO Dep.

Stability characteristics of conventional finite-difference and the finite-moments algorithms for solving the time-dependent transport equation are analyzed. Relations for the temporal error growth factor are derived for the source-free equation, and the implication of adding a source term is discussed. 10 refs.

13743 (UCRL-JC–105542) **A killer micro attack on 3D neutron transport.** Dorr, M.R.; Ferguson, J.M. Lawrence Livermore National Lab., CA (USA). 16 Nov 1990. 12p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9011149–12: 1990 nuclear explosives code developers' conference, Monterey, CA (USA), 6-9 Nov 1990). Order Number DE91008503. Source: OSTI; NTIS; GPO Dep.

In this paper, we describe the deterministic solution of the neutron transport equation and the computation of the effective criticality of three-dimensional assemblies using the BBN TC2000 killer micros. We observe that the performance of our research code PTRAN running on 48 processors of the TC2000 is competitive with the partially vectorizable version running on a single Cray Y/MP processor. This performance scales well with the number of processors on real problems, including those that are not load balanced a priori. To obtain this performance, we explicitly specify and exploit data locality and data dependence using domain decomposition and dynamic job scheduling. From the results obtained here, it appears that, at least for this application, a production machine based on the TC2000 architecture with more powerful processors and a commensurate increase in switch speed could yield a significant gain in our design capability. 2 refs., 5 figs., 2 tabs.

6550 Medical Physics

Refer also to citation(s) 12890, 13556

13744 (INIS-BR–2387) **Use of thermoluminescent dosimetry in gamma radiation fields studies.** Carron, W. Sao Paulo Univ., Piracicaba, SP (Brazil). Escola Superior de Agricultura Luiz de Queiroz. 1987 97p. (In Portuguese). Order Number DE91622618. Source: OSTI; NTIS (US Sales Only); INIS.

The depth-dose curves for gamma rays in material of interest to agronomy were obtained using lithium fluoride thermoluminescent dosimeters. The dose conversion factors for LiF were determined from curves of the absorved dose versus depth in water, wood and soil. Mathematics equations were chosen to best fit these curves. In the view of the results we came to the conclusion that in the studied materials the absorved radiation dose presents a great variation to the depth and could be correlated through of the exponential regression. (author).

13745 (INIS-CL–003) **Characterization of plastic nuclear track detectors on solid state, CR-39 and LR-115 and its possibilities application on thermal and fast neutron dosimetry.** Vallejo Delgado, L.R. Universidad Austral de Chile, Valdivia (Chile). 1989 215p. (In Spanish). Order Number DE91622619. Source: OSTI; NTIS (US Sales Only); INIS.

This work is an study about the use feasibility of plastic nuclear track detectors, LR 115, II-B (of Eastmann Kodak Co) and CR-39 (of American Acrylics and Plastics), for thermal and fast neutron dosimetry, respectively. The LR-115 with converter (n, alpha) was exposed to thermal neutrons with energy of 0,046 e V, proceeding from nuclear reactor RECH-1 of Nuclear Energy Chilean Commission. The irradiated films were submited to a chemical etching with NaOH, plus a washing and brushing. The CR-39 with polyethylene irradiator, was exposed to fast neutrons proceeding of calibrated sources of Am-Se. The irradiated plates were submited to a chemical pre-etching with KOH and a electrochemical post-etching. (author).

13746 (INIS-mf–12796, pp. 71-74) **Radiation situation in the Dukovany nuclear power plant and its environs.** Kopec, J. (Jaderna Elektrarna, Dukovany (Czechoslovakia)); John, A.; Hakl, J.; Londyn, P.; Zelenka, Z. Jaderna Elektrarna, Dukovany (Czechoslovakia). Apr 1990. 246p. (In Czech). (CONF-9004282–: Operation and maintenance of nuclear power plant, Nove Mesto na Morave (Czechoslovakia), 24-26 Apr 1990). In *Operation and maintenance of nuclear power plant: National conference proceedings.* Order Number DE91623406. Source: OSTI; NTIS (US Sales Only); INIS.

In dosimetric monitoring of the radiation situation, particular attention is paid to the activities of the primary coolant circuit and of the steam generator surface blowdown. Gamma dose rates are permanently monitored in the working environment. Personnel dosimetry uses film dosimetry complemented by thermoluminescence dosimetry. Data are computer-processed. The environmental impacts are monitored by measuring releases into water and air and by determining concentrations of artificial radionuclides in environmental samples. Tritium bulk activity increased in the Mohelno dam and in the Jihlava river. The environmental radiological impacts are very low. The radiological protection and safety levels can be improved by improving the material and technological base. (M.D.).

13747 (INS-T–498, pp. 115-124) **Dosimetry of biological tissue irradiation with light ion beam.** Nakamura, Takashi (Tohoku Univ., Sendai (Japan)); Uwamino, Yoshiaki; Okubo, Tohru. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1990. (In Japanese). (CONF-9003240–: Workshop on TARN II, Tanashi (Japan), 23-24 Mar 1990). In *Workshop on TARN II.* 130p. Order Number DE91745029. Source: OSTI; NTIS (US Sales Only); INIS.

High-energy heavy ions are considered to be able to provide a very useful tool for the treatment and diagnosis of cancer compared with other types of radiations such as electron beam, X-ray and gamma ray though sufficient basic data on their biological effect have not been made available to permit its practical application to treatment and diagnosis. The present report describes a study on the dosimetry for irradiated biological samples, which was

carried out as part of a research project for investigating the biological effect of high-energy heavy ions to provide basic data for the treatment and diagnosis of cancer. A facility for irradiation of biological samples, called TARN II, is described first. It comprises a heavy-ion synchrotron storage ring with an average diameter of 24m, and has a slow extraction line. The accelerable particles are the proton, alpha particle, and the heavy ions of carbon, nitrogen, neon and argon. A parallel plate type tissue equivalent ionization chamber is used for dosimetry. This chamber permits accurate measurement because the ratio between the stopping power for biological tissue and that for gas does not depend significantly on the beam energy. The limit to the irradiation by TARN II is estimated at around several tens Gy. (N.K.).

13748 (KFA-ASS–0431) **Operations report 1985 of the Department of Safety and Radiation Protection.** Hille, R. (ed.); Frenkler, K.L. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Abt. Sicherheit und Strahlenschutz. Apr 1986. 207p. (In German). Order Number DE91754793. Source: OSTI; NTIS (US Sales Only); INIS.

Under the heading 'Licensing' the report deals with licensing procedures and the handling of nuclear-fuels and radioactive materials. Operational radiation protection is concerned with operational and personnel monitoring, mathematical methods and safety analyses. Environmental protection deals with emission control, immission monitoring and meteorological measurements, and safety technology with α/β-analysis, dosimetry, equipment servicing and mechanics, nuclear material safeguards. Other subdepartments take care of industrial safety, physical protection, emergency protection and training. Subjects dealt with, too, are dispersion pollutants in atmosphere and environment, further development of radiation protection methods, and the bibliography of radiation protection in KFA. (HK).

13749 (LA-UR–91-468) **Radiation dose calculations with the Monte Carlo method.** Hsu, Hsiao-Hua. Los Alamos National Lab., NM (USA). [1991]. 10p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9103132–1: 2. environmental radiation monitoring technology symposium, Taiwan (China), 11-14 Mar 1991). Order Number DE91008582. Source: OSTI; NTIS; INIS; GPO Dep.

For high penetrating radiations such as neutrons and high-energy gamma rays, that deposit their energies uniformly over a large volume of a target medium, the determination of dose is commonly based on calculating the flux and then applying flux-to-dose conversion factors. For charged particles and low-energy gamma and x-rays, their energies are deposited locally, and flux-to-dose conversion factors could be complex functions of medium geometry and source conditions. Using an isotropic beta source, we calculated the doses in water layers (used to simulate tissue), and found that dose values depend on the size and shape of the water "cell." We recommend that a "standard" size and shape of tissue equivalent material be established for beta dose calculations. 7 refs., 2 figs., 4 tabs.

13750 (NIRS-M–76) **Characteristics of the human body and other relevant factors in dose assessment.** Kawamura, H.; Ohmomo, Y. (eds.). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1990. 253p. (In Japanese). (CONF-8812154–: 16. NIRS seminar on environmental research, Chiba (Japan), 1-2 Dec 1988). Order Number DE91755683. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers presented at the 16th National Institute of Radiological Science Seminar on Environmental Research. The 18 of the presented papers are indexed individually. (J.P.N.).

13751 (ORNL/TR–90/29) **A calculational method of photon dose equivalent based on the revised technical standards of radiological protection law.** Tanaka, Shun-ichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Suzuki, Tomoo. Oak Ridge National Lab., TN (USA). Mar 1991. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91008917. Source: OSTI; NTIS; INIS; GPO Dep.

The effective conversion factor for photons from 0.03 to 10 MeV were calculated to convert the absorbed dose in air to the 1 cm, 3 mm, and 70 μm depth dose equivalents behind iron, lead, concrete, and water shields up to 30 mfp thickness. The effective conversion factor changes slightly with thickness of the shields and becomes nearly constant at 5 to 10 mfp. The difference of the effective conversion factor was less than 2% between plane normal and point isotropic geometries. It is suggested that the present method, making the data base of the exposure buildup factors useful, would be very effective as compared to a new evaluation of the dose equivalent buildup factors. 5 refs., 7 figs., 22 tabs.

13752 (PNL-SA–18646) **Technical basis for establishing residual radioactive concentrations.** Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)); Meck, R.A. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 11p. Sponsored by Nuc. DOE Contract AC06-76RL01830. (CONF-910270–26: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91008827. Source: OSTI; NTIS; INIS; GPO Dep.

The US Nuclear Regulatory Commission (NRC) regulates the release of slightly radioactive property for unrestricted use. On July 3, 1990, the NRC published a Policy Statement concerning slightly radioactive materials that are below regulatory concern (BRC). The BRC Policy Statement "establishes the framework within which the Commission will formulate rules or make licensing decisions to exempt from some or all regulatory controls certain practices involving small quantities of radioactive material." The heart of the NRC Policy Statement on BRC material is its individual and collective radiation dose limits. To ensure a uniform approach and consistent regulatory decisions, the NRC authorized the development of a comprehensive technical basis that considers the translation of residual contamination levels to annual dose. Radiation doses from residual contamination in buildings and soil are derived from a generic radiation exposure scenario analysis. This paper describes the development of the comprehensive technical basis for translating residual contamination levels to annual dose, provides the modeling details of an example scenario, and presents a comparison of results with existing guidance in Regulatory Guide 1.86. 4 refs., 1 fig., 2 tabs.

13753 (PSI–85) **Dose determination of 600 MeV proton irradiated specimens.** Gavillet, D. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1991. 33p. Order Number DE91623390. Source: OSTI; NTIS (US Sales Only); INIS.

The calculation method for the experimental determination of the atomic production cross section from the γ activity measurements are presented. This method is used for the determination of some isotope production cross sections for 600 MeV proton irradition in MANET steel, copper, tungsten, gold and titanium. The results are compared with some calculation. These values are used to determine the dose of specimens irradiated in the PIREX II facility. The results are discussed in terms of the irradiation parameters. A guide for the use of the production cross section determined in the dosimetry experiment are given. (author) tabs., refs.

6560 Condensed Matter Physics

Refer also to citation(s) 13026, 13034, 13194, 13602, 13859

13754 (BNL–45443) **High current photoemission with 10 picosecond uv pulses.** Fischer, J.; Srinivasan-Rao, T.; Tsang, T. Brookhaven National Lab., Upton, NY (USA). Jun 1990. 32p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9006242–6: Workshop on short pulse high current cathodes, Bendor (France), 18-22 Jun 1990). Order Number DE91009439. Source: OSTI; NTIS; INIS; GPO Dep.

The quantum efficiency and the optical damage threshold of various metals were explored with 10 ps, 266 nm, UV laser pulses. Efficiencies for Cu, Y, and Sm were: 1.4, 5, and 7×10^{-4}, with damage thresholds about 100, 10, and 30 mJ/cm^2. This would permit over 1 μC/cm^2 or current densities exceeding 100 kA/cm^2. High charge and current densities of up to 66 kA/cm^2 were obtained on 0.25 mm diam cathodes, and 21 kA/cm^2 on a 3 mm diam yttrium cathode. The maximum currents were limited by space charge and the dc field. The experiments with small area illumination indicate that the emitted electrons spread transversely

due to Coulomb repulsion and their initial transverse velocity. This increases the effective area above the cathode, reduces the space charge effect and increases emission density on the cathode. The quantum efficiency can be increased substantially by enhancing the field on the surface by either a suitable electrode geometry or microstructures on it. 14 refs., 12 figs., 3 tabs.

13755 (BNL–45578) **Effects of the non-vanishing tip size in mechanical profile measurements.** Church, E.L. (Army Armament Research, Development and Engineering Center, Dover, NJ (USA)); Takacs, P.Z. Brookhaven National Lab., Upton, NY (USA). Aug 1990. 12p. Sponsored by USDOE,. DOE Contract AC02-76CH00016. (CONF-900756–59: 34. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE91008435. Source: OSTI; NTIS; GPO Dep.

The high-spatial-frequency behavior of mechanical-profiling instruments is determined principally by the non-linear geometrical interaction between the stylus tip and the surface irregularities. There is considerable interest in the nature of this interaction and its effects in practical applications. This paper explores the these issues analytically and presents a variety of results with emphasis on the frequency-domain description. Smooth surfaces are treated by perturbation theory and are found to be roughened by tip-size effects, while rough surfaces are smoothed. In lieu of closed form results for rough surfaces, we offer a simple conjecture regarding the nature of tip-size distortions and the maximum useable spatial frequency. 15 refs.

13756 (BNL–45888) **Experimental investigation of scattering of magnetostatic waves by surface acoustic waves.** Hanna, S.M. (Brookhaven National Lab., Upton, NY (USA)); Murphy, G.P.; Sabetfakhri, K.; Stratakis, K. Polytechnic Inst. of New York, Farmingdale, NY (USA). [1990]. 4p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC02-76CH00016. Grant ECS-8722155. (CONF-901202–1: Ultrasonics symposium, Honolulu, HI (USA), 5-7 Dec 1990). Order Number DE91009435. Source: OSTI; NTIS; GPO Dep.

Single-crystal yttrium iron garnet films are known for their low propagation loss for both magnetostatic and acoustic waves. We have investigated the Bragg scattering of magnetostatic waves off travelling gratings generated by surface acoustic waves. Experimental results for collinear and noncollinear scattering of magnetostatic forward volume waves are reported. For the noncollinear case, scattering of magnetostatic waves at different Bragg angles have been studied. Our results are in good agreement with the theoretical predictions based on the coupled-mode analysis. 5 refs., 7 figs.

13757 (CONF-900866–2) **Theory of structure and properties of hydrogenated amorphous silicon.** Chiarotti, G.L. (International School of Advanced Studies, Trieste (Italy)); Car, R.; Buda, F.; Parrinello, M. Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Physics. [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER45347. From 20. international Union of Pure and Applied Physics of semiconductors; Thessaloniki (Greece); 6-10 Aug 1990. Order Number DE91009353. Source: OSTI; NTIS; GPO Dep.

We have generated a computer model of hydrogenated amorphous silicon by first-principles molecular dynamics. Our results are in good agreement with the available experimental data, and provide new insight into the microscopic structure of this material. This should lead to a better understanding of the hydrogenation process. 13 refs., 2 figs.

13758 (CONF-9006242–5-Vugraphs) **High brightness electron beam production by laser induced various order multiphoton photoeffects of gold.** Toth, Cs. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Farkas, Gy.; Charalambidis, D.; Hontzopoulos, E.; Fotakis, C. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. [1990]. 7p. From Workshop on short pulse high current cathodes; Bendor (France); 18-22 Jun 1990. Order Number DE91009150. Source: OSTI; NTIS (US Sales Only).

This paper discusses the laser induced electron emission from metals and comparative measurements on various order multiphoton photoeffects.

13759 (GSI–90-70(prepr.)) **Large electron polarization of H-like ^{20}Ne-ions traversing Gd foils at very high velocities.** Speidel, K.H. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik); Cub, J.; Reuter, U.; Passek, F.; Simonis, H.J.; Gollwitzer, N.; Wollersheim, H.J.; Martin, N.; Egelhof, P.; Emling, H.; Henning, W.; Simon, R.S.; Schmidt, R. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Dec 1990. 15p. Order Number DE91756668. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that transient magnetic fields in Gd-host for ^{20}Ne ions at a mean velocity of 12.5 v_0 (v_0=c/137), considerably beyond the Bohr velocity of 1s electrons of Ne ions (v_{1s}=10v_0), are dominated by the Fermi contact field of these electrons. The first excited 2^+-state of ^{20}Ne was used as probe. The derived value for the mean degree of polarization p_{1s}=0.32(13), is surprisingly large, though still consistent with values obtained at lower velocities. Present calculations of spin exchange cross sections severely underestimate the observed polarization at this high velocity. (orig.).

13760 (LA–12020) **Structure of shocks in solids and liquids: Six reprints with an introduction.** Wallace, D.C. Los Alamos National Lab., NM (USA). Jan 1991. 69p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91008497. Source: OSTI; NTIS; GPO Dep.

This monograph consists of six papers on the theory of shocks in solids and liquids, reprinted from Physical Review, together with an introduction summarizing the complete shock theory and its limitations. The shock theory of this monograph is based on the principles of irreversible thermodynamics, characterized as follows. First, in equilibrium thermodynamics, materials are required to pass through states which lie on the equilibrium surface. In irreversible thermodynamics, materials pass through nonequilibrium states, but only those states which are close to the equilibrium surface, specifically, those states for which the equilibrium properties of temperature and entropy are still reasonably well defined. To construct an irreversible thermodynamic theory it is necessary to define the variables which measure the departure from equilibrium, to express the effect of these variables by a modification of the equilibrium thermodynamic equations, and to write an equation for the (irreversible) entropy generation. These principles are applied to planar shocks in the reprints collected here.

13761 (LBL–28685) **Broad-beam, high current, metal ion implantation facility.** Brown, I.G.; Dickinson, M.R.; Galvin, J.E.; Godechot, X.; MacGill, R.A. Lawrence Berkeley Lab., CA (USA). Jul 1990. 13p. Sponsored by U.S. Depar. DOE Contract AC03-76SF00098. Contract ARO-116-89;Contract N00014-88-F-0093. (CONF-900722–1: 8. international conference on ion implantation technology, Guildford (UK), 30 Jul - 3 aug 1990). Order Number DE91009329. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed a high current metal ion implantation facility with which high current beams of virtually all the solid metals of the Periodic Table can be produced. The facility makes use of a metal vapor vacuum arc ion source which is operated in a pulsed mode, with pulse width 0.25 ms and repetition rate up to 100 pps. Beam extraction voltage is up to 100 kV, corresponding to an ion energy of up to several hundred keV because of the ion charge state multiplicity; beam current is up to several Amperes peak and around 10 mA time averaged delivered onto target. Implantation is done in a broad-beam mode, with a direct line-of-sight from ion source to target. Here we describe the facility and some of the implants that have been carried out using it, including the 'seeding' of silicon wafers prior to CVD with titanium, palladium or tungsten, the formation of buried iridium silicide layers, and actinide (uranium and thorium) doping of III-V compounds. 16 refs., 6 figs.

6561 Superconductivity

Refer also to citation(s) 13085, 13086, 13093, 13094

13762 (LA-UR–91-567) **Bosonic mechanism for high-temperature.** Mueller, F.M. (Los Alamos National Lab., NM

(USA)); Arnold, G.B.; Swihart, J.C. Los Alamos National Lab., NM (USA). [1991]. 13p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910145–1: Electronic structure and mechanisms for high temperature superconductivity, Coral Gables, FL (USA), 3-9 Jan 1991). Order Number DE91008592. Source: OSTI; NTIS; GPO Dep.

The temperature dependent photoemission data of D. S. Dessau et al. show strong modulations in the superconducting state when compared to the normal state. These are similar to but larger than those seen historically in standard tunneling experiments in lower temperature superconductors. We have analyzed the Dessau data using Nambu-Eliashberg theory assuming some (as yet unknown) boson exchange as the primary mechanism for the superconductivity. The derived α^2F's, λ's and μ^*'s show features which resemble those derived from inversions of other low-temperature superconductors, albeit that λ here is about 8.67 and μ^* is approximately 0.15. Several bosonic mechanisms are considered. 29 refs., 3 figs.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 13215, 13256, 13259, 13682, 13816

13763 (CONF-9010321–1) **Time, dynamics and chaos: Integrating Poincare's "non-integrable systems".** Prigogine, I. Texas Univ., Austin, TX (USA). Center for Statistical Mechanics and Complex Systems. [1990]. 25p. Sponsored by Commission. DOE Contract FG05-88ER13897. Contract PSS 0143/B. From 26. nobel conference; St. Peter, MN (USA); 2-3 Oct 1990. Order Number DE91008316. Source: OSTI; NTIS; GPO Dep.

This report discusses the nature of time. The author attempts to resolve the conflict between the concept of time reversibility in classical and quantum mechanics with the macroscopic world's irreversibility of time. (LSP)

13764 (DOE/ER/13897–12) **The behavior of matter under nonequilibrium conditions: Fundamental aspects and applications: Progress report, April 15, 1990-April 14, 1991.** Prigogine, I. Texas Univ., Austin, TX (USA). Center for Statistical Mechanics and Complex Systems. Dec 1990. 7p. Sponsored by USDOE,. DOE Contract FG05-88ER13897. Order Number DE91008285. Source: OSTI; NTIS; GPO Dep.

Our report contains a brief summary of what has been achieved over the period of the contract. We have studied the behavior of matter under equilibrium conditions on three levels: (1) on the microscopic level in the frame of classical mechanics or of quantum theory; (2) on the stochastic level, which includes fluctuations; and (3) on the phenomenological, macroscopic level described by nonlinear equations. We first report on the level (1), then report on the levels (2) and (3).

13765 (ETDE-IT–91-13) **Evolution operator in classical mechanics: short note on use.** Dattoli, G.; Mari, C.; Torre, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1990. 5p. Order Number DE91752926. Source: OSTI; NTIS (US Sales Only); INIS.

The evolution operator plays a crucial role in quantum mechanics, to specify the time behaviour of a state ruled by a certain Hamiltonian operator. The body of computational techniques, both exact and perturbative, developed to deal with the evolution operator is immense and it would be greatly advantageous to transfer the relevant methods, developed within a quantum mechanical framework, to classical mechanics. This note, aimed at presenting this possibility, discusses simple, but illuminating examples. It also introduces a matrix formalism which allows a straightforward inclusion of the nonlinear terms.

13766 (GSI–90-24) **Generalization of the nuclear equation of state to nonequilibrium states.** Neise, L.W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Oct 1990. 250p. (In German). Order Number DE91754794. Source: OSTI; NTIS (US Sales Only); INIS.

In this thesis it was shown, how the thermodynamic terms can be generalized, so that they are also still applicable in nonequilibrium states. Thereby the method with a generalized grand canonical potential presented here is also applicable to two mutually steadily streaming through parts of nuclear matter. The momentum anisotropy is described by a parameter which enters the equation of state quite similarly as for instance the temperature. While now in a purely position-dependent microscopical interaction a momentum anisotropy only means an additional additive kinetic energy, momentum-dependent forces, as they play a role in nucleus-nucleus collisions, lead to complicated connections, which were analyzed in this thesis. An important advance of the procedure presented here is the relativistic formulation, which allows to study also large momentum anisotropies respectively large relative flow velocities. It could be shown that the formation of delta matter is forced by a momentum anisotropy. Especially interesting is the influence of a momentum anisotropy on the phase transition between hadronic matter and a quark-gluon plasma. (orig./HSI).

13767 (IC–89/205) **New proofs of ergodic theorems for non expansive sequences in a Hilbert space.** Djafari Rouhani, B. International Centre for Theoretical Physics, Trieste (Italy). Aug 1989. 12p. Order Number DE91621723. Source: OSTI; NTIS (US Sales Only); INIS.

Let $(x_n)_{n\geq 0}$ be a non expansive sequence in a real Hilbert space H, (i.e. every i,j $\geq$ 0, parallel $x_{i+1} - x_{j+1}$parallel$\leq$parallel $x_i - x_j$parallel) and $s_n = 1/n \sum_{i=0}^{n-1} x_i$. We prove the following results containing J.B. Baillon's ergodic theorems: (1) s_n converges weakly in H if and only if lim $\inf_{n\to+\infty}$ parallel $s_n$parallel $< +\infty$. (2) x_n converges weakly in H if and only if $(x_n)_{n\geq 0}$ is weakly asymptotically regular and lim $\inf_{n\to+\infty}$ parallel x_n parallel $< +\infty$. (3) If moreover: every i,j $\geq$ 0, parallel $x_{i+1} + x_{j+1}$parallel $\leq$ parallel $x_i + x_j$parallel then s_n converges strongly in H. This is obtained as a consequence of a result of H. Brezis and F.E. Browder which we prove here by using Herglotz's theorem. (4) Under the same assumptions as in (3) the sequence $(x_n)_{n\geq 0}$ converges strongly in H if and only if $(x_n)_{n\geq 0}$ is asymptotically regular. (author). 33 refs.

13768 (LA-UR–91-633) **Anyons in a magnetic field: Landau levels and vertex operator representation.** Dunne, G.V. (Massachusetts Inst. of Tech., Cambridge, MA (USA)); Lerda, A.; Trugenberger, C.A. Los Alamos National Lab., NM (USA). [1991]. 11p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910265–1: Texas Center for Superconductivity workshop on the physics and mathematics of anyons, Houston, TX (USA), 1-2 Feb 1991). Order Number DE91008599. Source: OSTI; NTIS; INIS; GPO Dep.

We construct exact many-body eigenstates of both energy and angular momentum for the N-anyon problem in an external magnetic field. Such states span the full ground-state eigenspace and have a natural representation in terms of the Fubini-Veneziano vertex operators of string theory. 19 refs.

13769 (SAND–90-2737) **Dynamics of rotating flexible structures by a method of quadratic modes.** Segalman, D.J.; Dohrmann, C.R. Sandia National Labs., Albuquerque, NM (USA). Dec 1990. 27p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. Order Number DE91009224. Source: OSTI; NTIS; GPO Dep.

The problem of calculating the vibrations of rotating structures has challenged analysts since the observation that use of traditional modal coordinates in such problems leads to the prediction of instability involving infinite deformation when rotation rates exceed the first natural frequency. Much recent published work on beams has shown that such predictions are artifacts of incorporating incomplete kinematics into the analysis, but that work addresses analysis of only simple structures such as individual beams and plates. The authors present a new approach to analyzing rotating flexible structures that applies to the rotation of general linear (unjointed) structures, using a system of nonlinearly coupled deformation modes. This technique is called a Method of Quadratic Modes. 37 refs., 5 figs., 1 tab.

70 FUSION ENERGY

Refer also to citation(s) 13700, 13882

7001 Plasma Research

Refer also to citation(s) 13820, 13823, 13833, 13857

13770 (CONF-890931–14) **WinGraphics: An optimized windowing environment for interactive real-time simulations.** Verboncoeur, J.P.; Vahedi, V. California Univ., Berkeley, CA (USA). Electronics Research Lab. [1989]. 4p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220. N00014-85-K-0809. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009831. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed a customized windowing environment, Win Graphics, which provides particle simulation codes with an interactive user interface. The environment supports real-time animation of the simulation, displaying multiple diagnostics as they evolve in time. In addition, keyboard and printer (PostScript and dot matrix) support is provided. This paper describes this environment.

13771 (CONF-901025–33) **High performance H modes in JET.** Tanga, A. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 18p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/A-4-1). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005488. Source: OSTI; NTIS; INIS; GPO Dep.

In JET the scientific properties and technical basis of good confinement regimes have been evaluated in the light of the potential extrapolation of such regimes to reactor requirements. In this paper the main experimental H-mode results are discussed highlighting global confinement scaling, low q regimes, the role of the target plate material, the density limit, and finally sawtooth suppression and hot-ion mode. 17 refs., 15 figs.

13772 (CONF-901025–35) **ICRF heating in reactor grade plasmas.** Jacquinot, J. (JET Joint Undertaking, Abingdon (UK)); Bhatnagar, V.P.; Bures, M.; Cottrell, G.A.; Eriksson, L.G.; Sack, C.H.; Start, D.F.H.; Taroni, A.; Hellsten, T.; Koch, R.; Moreau, D. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 12p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/E-2-1-1). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005491. Source: OSTI; NTIS; INIS; GPO Dep.

Impurity influxes in JET discharges due to ICRH have been reduced to insignificant levels. This has allowed high quality H-modes to be produced with ICRH alone and has enhanced the density limit which is now the same as the NBI limit. Improvement in the deuterium fuel fraction has led to the generation of 100kW of non thermal ^{3}He-D fusion power. Alpha-particle simulations using MeV ions created by ICRH show classical energy loss and suggest that α-heating in a reactor will be highly efficient. A clear demonstration of TTMP damping of the fast wave in high beta plasmas has been achieved. A broadband ICRH system is proposed for NET/ITER which will allow fast wave current drive and central ion heating for burn control and ignition. 10 refs., 6 figs.

13773 (CONF-901025–36) **Sawteeth and their stabilization in JET.** Campbell, D.J. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 12p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/A-6-3). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005459. Source: OSTI; NTIS; INIS; GPO Dep.

Sawtooth relaxations control the central plasma parameters in most JET discharges and, as a result, have a significant influence on fusion performance. Several techniques have, therefore, been developed for the stabilization of sawteeth in various JET operating regimes. Under some circumstances, sawtooth suppression appears to be associated with the central safety factor, q_0, rising above unity. However, in other cases, q_0 remains significantly below unity and it is thought that stabilization is due to the influence of a population of energetic particles. Detailed measurements of the evolution of the current profile in JET during sawteeth have confirmed that q_0 remains below unity throughout the sawtooth cycle and thus the trigger for the sawtooth collapse remains problematic. Further diagnostic investigations of the sawtooth collapse have shown that the collapse takes the form of a convective plasma flow, but the cause of the resultant energy transport is not understood. 19 refs., 7 figs.

13774 (DOE/ER/53269–3) **Methods for testing transport models: First year annual report, [15 May 1990–14 May 1991].** Singer, C.; Cox, D. Illinois Univ., Urbana, IL (USA). 30 Jan 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER53269. Order Number DE91009354. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes progress over the previous year on methods for testing transport models. This includes considerable progress on developing statistical methods for testing theoretical plasma transport models and some initial results from this work. Additional progress is also reported on developing theoretical models with sufficient accuracy and flexibility to serve as useful test bed for applying these statistical methods. Our most fundamental result to date is that a single integrated transport model looks not only sufficient to reproduce a wide variety of experimental data, also but a necessary improvement over simple empirical confinement scalings. The way in which this conclusion was derived is described below. Some further work suggested by this conclusion is described briefly here, and in more detail in an accompanying description of work to be done under the second year of this three year contract. 9 refs.

13775 (DOE/ER/53276–3) **Colorado School of Mines fusion gamma ray diagnostic project: Technical progress report.** Cecil, F.E. Colorado School of Mines, Golden, CO (USA). 28 Feb 1991. 23p. Sponsored by USDOE,. DOE Contract FG02-88ER53276 ;FG02-87ER40342 ;AC02-76CH03073. Order Number DE91009259. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of our fusion gamma ray project continues to be the development of fusion gamma ray spectrometry as a diagnostic of high temperature fusion plasmas. The three broad areas in support of this purpose are: Measurement of gamma ray producing reactions at low energies; development of gamma ray spectrometers capable of measuring the gamma ray yields from current and proposed fusion plasma devices; and determination of appropriate plasma parameters from measured fusion gamma ray yields at present fusion plasma devices. This report summarizes the progress made in these three areas. In the next section we summarize our recently completed measurement of the radiative capture of protons by the nuclei ^{6}Li, ^{7}Li, ^{9}Be and ^{11}B. We also present preliminary results of our investigation of the radiative capture of deuterons by ^{6}Li and ^{10}B as well as additional data taken on the reaction D(d,γ)^{4}He at very low energies.

13776 (DOE/ER/53302–3) **Kinetic stability of field-reversed configurations: Final report, December 15, 1989–December 14, 1990.** Staudenmeier, J.L.; Hsiao, M.-Y. Pennsylvania State Univ., University Park, PA (USA). Dept. of Nuclear Engineering. Jan 1991. 133p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-90ER53302. Order Number DE91009530. Source: OSTI; NTIS; INIS; GPO Dep.

The internal tilt mode is considered to be the biggest threat to Field-Reversed Configuration (FRC) global stability. The tilt stability of the FRC is studied using the MHD, Hall MHD, and the Vlasov-fluid (Vlasov ions, cold massless fluid electrons) models. Nonlinear Hall MHD calculations showed that the FRC was stable to the tilt mode when the s value of the FRC was below a critical value that was dependent on plasma length. The critical s value is larger for longer plasma equilibria. The stability of FRC's with toroidal field was studied with a linear initial value MHD code. The calculations showed an axial perturbation wavelength of the most unstable eigenfunction that was consistent with internal probe measurements made on translated FRC's. Linear Vlasov-fluid eigenvalue calculations showed that kinetic ion effects can change both the growth rate and the structure of the eigenfunctions when compared to the corresponding MHD modes. Calculations on short FRC equilibria indicate that MHD is not the appropriate small gyroradius limit of the Vlasov-fluid model because the axial transit time of a thermal ion is approximately equal to an MHD growth time for the tilt mode. Calculations were done using a small number of unstable MHD eigenfunctions as basis functions in order to reduce the dimensionality of the stability problem. The results indicated that this

basis set can produce inaccurate growth rates at large value for s for some equilibria.

13777 (DOE/ER/54088–1) **Laser diagnostics for plasma turbulence: Final report.** Thermo Electron Technologies Corp., San Diego, CA (USA). [1991]. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-90ER54088. Order Number DE91009377. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this effort is to further develop the multiple-beam laser scattering diagnostic for tokamak plasmas. Present laser scattering diagnostics have very poor spatial resolution. Yet good spatial resolution is necessary if adequate comparison of theory and experiment is to occur. The proposed multiple beam scattering diagnostic promises a spatial resolution of ~10 cm at a fluctuation wave number of 5 cm^{-1} when the angular envelope of the beams is 0.1 radian. A larger angular envelope would further improve the spatial resolution. This kind of spatial resolution is impossible with current laser scattering diagnostics. Enclosed are two items. These items constitute the major results of this study. Appendix "A" is a draft of a paper being prepared for submission to the journal "Review of Scientific Instruments." This paper consists of three sections. Section 1 compares the proposed diagnostic to conventional laser scattering diagnostics and argues for the need of increased spatial resolution. Section 2 presents a thorough rendering of the conceptual basis of the proposed multiple beam diagnostic. Section 3 presents an optical design suitable for use on the TEXT Upgrade tokamak. Appendix "B" is a schematic of a proposed proof-of-principle bench-top experiment of the multiple beam scattering diagnostic. It is designed to demonstrate the concept thoroughly at a greatly reduced cost. An actual multiple beam CO_2 laser scattering experiment on a controlled laboratory plasma would be a good follow on before attempting construction of the diagnostic on a major tokamak.

13778 (ENEA-RT-FUS–89-14) **Poloidal Ohm's law and profile constraint in tokamaks.** Zanza, V.; Segre, S.E. ENEA, Frascati (Italy). Centro Ricerche Energia. Sep 1990. 16p. (RT/FUS–89-14). Order Number DE91752905. Source: OSTI; NTIS (US Sales Only); INIS.

In the analysis of toroidal equilibria, the derivation of the poloidal current by the explicit use of the poloidal component of Ohm's law, together with the radial plasma velocity (obtained from the distribution of plasma sources), leads to a very general constraint of the possible radial profiles of plasma density and temperature. The constraint does not require any ad hoc assumption; it can place severe restrictions on allowed profiles and is independent of energy and particle transport; it may be at the basis of profile consistency. The constraint is discussed using results from the FT tokamak.

13779 (ENEA-RT-FUS–89-15) **Stability of ion-temperature-gradient driven modes in tokamaks with magnetic separatrix.** Briguglio, S. ENEA, Frascati (Italy). Dipt. Fusione. Sep 1990. 24p. (RT/FUS–89-15). Order Number DE91752923. Source: OSTI; NTIS (US Sales Only); INIS.

The stability of the ion-temperature-gradient driven modes is analyzed for a model equilibrium with a magnetic separatrix. In the flat-density-profile limit the separatrix comes out to be stabilizing, causing the ion temperature gradient to increase. In the steep-density-gradient limit the effect of the separatrix is destabilizing. Both these results are more pronounced for configurations with an outside x point.

13780 (ENEA-RT-FUS–89-26) **Computation of change of first wall-toroidal limiter power flux deposition profile due to axisymmetric plasma displacement, for triangular simplified equilibria in tokamak: Application to IGNITOR case.** Ferro, C.; Zanino, R. ENEA, Frascati (Italy). Dipt. Fusione; Politecnico di Torino, Turin (Italy). Sep 1990. 17p. (RT/FUS–89-26). Order Number DE91752900. Source: OSTI; NTIS (US Sales Only); INIS.

In tokamaks, the scrape-off layer (SOL) is at least 2D in nature. Still, in the attempt of exemplifying the very different physics along and across the magnetic field lines, two large areas of activity can be identified: the estimation of the transport parameters across the magnetic field to determine radial profiles in the SOL; the analysis of plasma transport along field lines, to examine the possibility of strong temperature and density gradients in that direction, and the formation of a radiating layer within the SOL. Under the assumption of a simple SOL (no SOL radiation, no significant gradients along field lines), this paper addresses the question: how is the thermal load distributed on the first wall-toroidal limiter in a tokamak, when the center of the plasma column is axisymmetrically displaced from its design location? Interest in this problem is due to the fact that the control of the plasma position is hardly perfect, and that the FW geometry is (and typically can only be) optimized for the nominal plasma position and shape. In this analytic treatment of the heat load problem, the power deposition profiles are calculated in a parametric form for a D-shaped configuration (IGNITOR case). The variation of the maxima of thermal loads is reported as a function of displacement of plasma equilibrium configuration with respect to the plasma chamber configuration.

13781 (ENEA-RT-FUS–89-27) **Long wavelength limit of ion-temperature-gradient mode in tokamak plasmas.** Chen, L.; Briguglio, S.; Romanelli, F. ENEA, Frascati (Italy). Dipt. Fusione. Sep 1990. 10p. (RT/FUS–89-27). Order Number DE91752903. Source: OSTI; NTIS (US Sales Only); INIS.

The stability of the ion temperature gradient (delTi) mode in tokamak geometries is examined in the limit of long wavelength and flat density, retaining the non-adiabatic electron response. The existence of three unstable branches is shown. The toroidicity-induced delTi branch tends to be stabilized for increasing wavelengths by the finite sigma Ti (sigmaTi=LTi/R) corrections. Meanwhile, the slab-like delTi branch remains unstable and is little affected by the electron dynamics. The third branch corresponds to toroidicity-induced delTi eigenmodes propagating, however, in the electron diamagnetic direction, which are destabilized via non-adiabatic electron dynamics. At shorter wavelengths, the toroidicity-induced delTi branch remains strongly unstable; while the other branches become stabilized.

13782 (ETDE-IT–91-07) **Edge parameters and scrape-off layer (SOL) characteristics in IGNITOR.** Ferro, C.; Zanino, R. ENEA, Frascati (Italy). Centro Ricerche Energia; Politecnico di Torino, Turin (Italy). 1990. 16p. (CONF-900505–14: 9. plasma surface interactions in controlled fusion devices conference, Bournemouth (UK), 20-25 May 1990). Order Number DE91752901. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at 9th international conference on plasma surface interactions (Bournemouth, 21-25 May 1990).

For IGNITOR, a high field tokamak conceived to reach ignition, the ignited scenario considers operation at an average electron density of about $6x10^{20}$ m^{-3} and average temperature of about 5 keV. The scrape-off layer (SOL) plasma properties are, consequently, very different from those of present machines. Based on extrapolation, from the FT (Frascati tokamak) and other limiter machines and using self-consistent global models, the SOL properties in IGNITOR are: density decay length approx. $1x10^{minus2}$ m, $2.5x10^{20}$ m^{minus3} density at the last closed flux surface (LCFS), and temperature at the LCFS lower than 60 eV. All the parameters have a small dependence on the radiated power. In addition, a strong screening of the SOL results from the calculations. Analysis of plasma edge parameters at the LCFS shows that the 'Knudsen number' in IGNITOR is lower than in all other machines and the SOL can be treated as a fluid. In this regime, the energy balance is dominated by distributed processes ('complex SOL') instead of by the sheath near the wall ('simple SOL'). The criteria necessary to have a complex SOL are all satisfied for IGNITOR edge conditions and there is a credible guess that a clean plasma could be obtained in IGNITOR together with a 'remote radiative' scenario.

13783 (ETDE-IT–91-16) **Calibration of neutron activation system on FTU: Comparison between measured and calculated activation response coefficients.** Angelone, M.; Batistoni, P.; Martone, M.; Pillon, M.; Rapisarda, M.; Rollet, S. ENEA, Frascati (Italy). Centro Ricerche Energia. 1990. 21p. Order Number DE91752929. Source: OSTI; NTIS (US Sales Only); INIS.

The Frascati Tokamak Upgrade (FTU) neutron activation system was calibrated using indium foils and californium 252 spontaneous fission neutron source located in several positions within the tokamak. The same experimental arrangements were simulated with the Monte Carlo Neutron and Photon Transport code MCNP, in order to reproduce numerically the activation response coefficients

measured experimentally. The main purpose of the comparison was to assess the accuracy of the numerical simulation and of the modelling of the FTU device. This analysis has a more general relevance in view of the use of activation systems in Next Step devices, like NET/ITER, as an independent method for the absolute measurement of the neutron yield. An overall agreement at the 22% level between experiment and calculation was demonstrated.

13784 (GA-A–20272) **Role of the edge electric field and microturbulence in the L-H transition.** Groebner, R.J. (General Atomics, San Diego, CA (USA)); Burrell, K.H.; Carlstrom, T.N.; Gohil, P.; Seraydarian, R.P; Peebles, W.A.; Doyle, E.J.; Philipona, R.; Matsumoto, H.; Cluggish, B. General Atomics, San Diego, CA (USA). Nov 1990. 11p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. (CONF-901025–41: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990). Order Number DE91008925. Source: OSTI; NTIS; INIS; GPO Dep.

Two clear signatures of the L-H transition in the DIII-D tokamak are that the edge poloidal rotation velocity v_θ abruptly increases, implying that the radial electric field E_r becomes more negative, and the level of density fluctuations is abruptly suppressed in a narrow region at the plasma edge. The absolute values of E_r and v_θ have maxima within 1-2 poloidal gyroradii $\rho_{i\theta}$ of the plasma edge, indicating that large negative and positive gradients of E_r and v_{theta} exist near the plasma edge in a region called the "shear" layer. Density fluctuations are reduced and the gradients of T_i, T_e, n_e and the carbon density increase in the shear layer at the time of transition. These data qualitatively support theoretical scenarios in which changes in E_r or of the gradients of E_r or v_θ cause a suppression of microturbulence, resulting in increases in the T_i and density gradients. 22 refs., 3 figs.

13785 (GA-A–20277) **Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak.** Burrell, K.H. (General Atomics, San Diego, CA (USA)); Groebner, R.J.; Carlstrom, T.N.; Dominguez, R.R.; Gohil, P.; Lohr, J.M.; Petrie, T.W.; Sager, G.T.; StJohn, H.E.; Schissel, D.P.; Kurki-Suonio, T.S.; Jong, R.A.; Porter, G.D.; Matsumoto, H.; Wolfe, S.M.General Atomics, San Diego, CA (USA). Nov 1990. 18p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. (CONF-901025–42: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990). Order Number DE91008924. Source: OSTI; NTIS; INIS; GPO Dep.

We have studied local thermal and angular momentum transport in the bulk of neutral-beam-heated, hot-ion L-mode and H-mode plasmas in DIII-D. This work has been done at reactor-relevant central ion temperatures up to 14.5 keV and normalized beta values up to $\beta_N = 3$, which approach the beta limit seen in DIII-D. Significant improvement in local transport has been seen for the L to H transition. This demonstrates that the confinement improvement in H- mode is not simply due to the creation of a transport barrier at the plasma edge. The dominant improvement is in the electron thermal and angular momentum transport. Ion transport is at the neoclassical level in the center of the H-mode discharges. The local transport in the outer half of the plasma improves markedly within 10 ms after the L to H transition. The electron density profile flattens in this region on the same time scale. This connection leads to the speculation that the confinement improvement is caused by this flattening. Comparison of experimental results with the predictions of electrostatic, drift-wave-induced transport show significant disagreement. Magnetic-fluctuation-based models agree better with experiment, but still exhibit significant discrepancies. Complete, quantitative agreement between theory and experiment will require further improvement in the theory. 36 refs., 6 figs.

13786 (GA-A–20281) **Electron cyclotron heating and current drive results from the DIII-D tokamak.** Luce, T.C. (General Atomics, San Diego, CA (USA)); Harvey, R.; Lohr, J.; Prater, R.; Snider, R.; Stallard, B.; Stockdale, R.; James, R.A.; deHaas, J.; Fyaretdinov, A.; Gorelov, Yu; Trukhin, V.; de Gentile, B.; Giruzzi, G.; Rodriguez, L.; Janz, S. General Atomics, San Diego, CA (USA). Nov 1990. 14p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. (CONF-901025–44: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990; IAEA-CN–53/E-1-2). Order Number DE91008922. Source: OSTI; NTIS; INIS; GPO Dep.

Auxiliary heating experiments with electron cyclotron heating have been carried out in the DIII-D tokamak. Waves at 60 GHz have been launched at power levels up to 1.4 MW from both the high-field and low-field side with the appropriate polarization for damping at the fundamental resonance (2.14 T). Confinement was studied in L-mode and H-mode plasmas for a single-null, open divertor geometry. For L-mode discharges, the energy confinement scaling agrees well with the ITER-89 power law or offset linear scaling relations. With strong off-axis heating, the electron temperature profile remains peaked, and power balance analysis indicates that the transport cannot be described by a purely diffusive model. In H-mode confinement plasmas, the magnitude and scaling of the confinement time are equal to that of plasmas heated by neutral beam injection (NBI), if the energy stored in the fast ions is removed in the NBI cases. A major issue for steady-state H-mode plasmas is control of the edge-localized mode (ELM) behavior. By moving the resonance location ±5 cm around the separatrix, the frequency of giant ELMs can be changed by a factor of three. Noninductive current drive with electron cyclotron waves has also been investigated. Driven currents up to 70 kA have been observed, but the current drive is enhanced by the residual dc electric field. Currents aiding and opposing the Ohmic current have been measured. The magnitude of the current for co-current drive is greater than expected from modeling which includes trapped particle effects, but no electric field. Preliminary calculations including the residual dc electric field can account for the observed enhancement.

13787 (GA-A–20283) **Profile optimization and high beta discharges and stability of high elongation plasmas in the DIII-D tokamak.** Taylor, T.S. (General Atomics, San Diego, CA (USA)); Chu, M.S.; Ferron, J.R.; Helton, F.J.; Howl, W.; Jackson, G.L.; Jensen, T.H.; Kellman, A.G.; Lao, L.L.; La Haye, R.J.; Leuer, J.A.; Osborne, T.H.; Snider, R.; Stambaugh, R.D.; Strait, E.J.; Turnbull, A.DGeneral Atomics, San Diego, CA (USA). Feb 1991. 19p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. (CONF-901025–46: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990; IAEA-CN–53/A-3-1). Order Number DE91008921. Source: OSTI; NTIS; INIS; GPO Dep.

The maximum experimental volume average toroidal beta in DIII-D scales with the plasma current divided by the plasma minor radius and the toroidal field, $\beta_T \propto I/aB$. $\beta_T = 11\%$ has been achieved at high normalized current by operating at high plasma elongation, $\kappa = 2.3$, and high triangularity, $\delta = 0.8$, near the axisymmetric stability limit. In a limited range of I/aB, $\beta_T(\%) = 5I/aB$ (MA/m/T) has been obtained. Stability calculations indicate that the high beta stability limit depends on the profiles of the current density, and the pressure. 37 refs., 7 figs., 1 tab.

13788 (IAEA-TECDOC–558, pp. 203-208) **Electron cyclotron heating experiments in CHS.** Iguchi, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). CHS Group. International Atomic Energy Agency, Vienna (Austria). Jul 1990. (CONF-890403–: 7. international workshop on stellarators, Oak Ridge, TN (USA), 10-14 Apr 1989). In *Stellarator physics: Proceedings of the seventh international workshop on stellarators, held in Oak Ridge, Tennessee, 10-14 April 1989.* 635p. Order Number DE91613178. Source: OSTI; NTIS (US Sales Only); INIS.

Electron cyclotron heating with 28 GHz gyrotron has been carried out in a low-aspect-ratio helical system CHS. Spatial profiles of electron density and temperature are measured in various heating and magnetic configurations. It is shown that the drift motion of the trapped particles across the magnetic surfaces play an important role in the energy transport in electron cyclotron heated currentless plasmas, especially in a low collisionality regime. It is concluded that optimization of particle orbit is of primary importance even for electron confinement in low aspect ratio helical systems like CHS. (author). 4 refs, 4 figs.

13789 (IAEA-TECDOC–558, pp. 265-268) **Experiment on RF plasma production in CHS.** Nishimura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics); Shoji, T. CHS Group. International Atomic Energy Agency, Vienna (Austria). Jul 1990. (CONF-890403–: 7. international workshop on stellarators, Oak Ridge, TN (USA), 10-14

Apr 1989). In *Stellarator physics: Proceedings of the seventh international workshop on stellarators, held in Oak Ridge, Tennessee, 10-14 April 1989.* 635p. Order Number DE91613178. Source: OSTI; NTIS (US Sales Only); INIS.

ICRF waves are applied to produce and heat a currentless plasma. Three waves (a whistler wave, a slow wave and an ion Bernstein wave) have been chosen for the plasma production. Two different type antennas are used to excite these waves. One is a pair of quarter turn antennas for the whistler wave excitation and another is the Nagoya Type-III antenna for excitation of the slow and ion Bernstein waves. Both antennas have Faraday shields. These antennas were designed to fit the plasma boundary. Plasma of n_e0=2-5x10^{12}cm^{-3}, T_e(0)=100-300eV and T_i(0)=200-300eV was produced and sustained with the RF only. (author). 2 refs, 5 figs.

13790 (IAEA-TECDOC–558, pp. 257-264) **Impurity behaviors of ECH and RF plasmas in CHS.** Morita, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). CHS Group. International Atomic Energy Agency, Vienna (Austria). Jul 1990. (CONF-890403–: 7. international workshop on stellarators, Oak Ridge, TN (USA), 10-14 Apr 1989). In *Stellarator physics: Proceedings of the seventh international workshop on stellarators, held in Oak Ridge, Tennessee, 10-14 April 1989.* 635p. Order Number DE91613178. Source: OSTI; NTIS (US Sales Only); INIS.

Spectroscopic measurements have been carried out for ECH and ICRF currentless plasmas. The results from the ECH plasmas are described for three typical operations of magnetic axis shift, limiter insertion and gas puff control. From the spectroscopy it is observed that the inward shift causes radiation collapse because of the severe contact with vacuum wall. Although the limiter insertion also causes the radiation collapse at the end of the 35ms discharge, it is due to the increase of the hydrogen recycling rate on the limiter surface. The discharge without gas puffing realizes a low-density and low-impurity concentration plasma (n_e=2x10^{12}cm^{-3}, T_e=800eV) indicating no buildup of the impurity. The ICRF plasma is produced with Ti gettering. The Ti gettering drastically suppressed a large amount of the oxygen influx. As a result, relatively long discharges of 12ms are obtained with parameters of n_e=3.5x10^{12}cm^{-3} and T_e=200-300eV. (author). 11 figs.

13791 (IPP–1/256) **Analysis and optimization of the edge plasma of Joule tokamak discharges.** Bessenrodt-Weberpals, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Duesseldorf Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 129p. (In German). Order Number DE91754662. Source: OSTI; NTIS (US Sales Only); INIS.

The following topics are discussed: Introduction (the principle of a Tokamak); Diagnostics of the edge plasma (Thomson scattering, Langmuir probes, laser-induced fluorescence); Computer Simulations of the Plasma Edge (atom physical data, transport models, neutral gas models); Characterization of the Edge Plasma (electron temperature and density, particle fluxes and recycling, transport within the plasma edge, edge limits, isotope effect); emission and transport of impurities (physical sputtering, plasma induced discharges, evaporation, chemical spray, sublimation, transport of impurities, profiles of impurities' concentration); Joule Discharges of high density (phenomenology, time dependence, particle transport in the edge plasma, correlations of the edge parameters, comparison with the detached plasma); Injection of Hydrogen Pellets (pellet ablation, plasma response, relaxation after pellet injection); Synopsis. (AH).

13792 (IPP–4/243) **Nonlinear coupling of lower hybrid grills and comparison with experimental data from ASDEX.** Petrzilka, V. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyziky Plazmatu); Leuterer, F. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Sep 1990. 23p. Order Number DE91754665. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper, computations of the reflection coefficient based on the nonlinear lower hybrid (LH) coupling theory are presented and compared with measurements of the reflection coefficient of the ASDEX tokamak LH grill, where powers of up to 4 kW/cm^2 have been launched. Such a LH power density modifies the electron density in front of the grill as a result of ponderomotive forces. This changes the coupling and the power reflection coefficient R. Comparison of computed reflection coefficients with experimentally observed ones suggests that heating of the plasma in front of the grill by the transmitted LH power has also to be taken into account in order to explain the observed saturation of the growth of the reflection coefficient with power. (orig.).

13793 (IPP–4/244) **Toroidal transport via the magnetic-field collisional anomaly.** Puri, S. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Oct 1990. 14p. Order Number DE91754669. Source: OSTI; NTIS (US Sales Only); INIS.

Toroidal transport due to the anomalous slowing down of low-parallel-velocity electrons (with gyroradius less than the Debye length) by the enhanced electron-ion collisions is investigated. Expressions for the particle, energy and canonical-angular-momentum diffusivities are obtained. Large diffusivities are found to occur at the cold, low-density edge and may be eliminated by a nominal increase of ion temperature at the edge, resembling the L-H mode transition in Tokamak plasmas. (orig.).

13794 (IPP–6/294) **Proof of a conjecture of Morrison and Pfirsch.** Weitzner, H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences); Pfirsch, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Oct 1990. 7p. Order Number DE91754666. Source: OSTI; NTIS (US Sales Only); INIS.

A necessary and sufficient condition for the existence of negative-energy modes in a plasma described by the Vlasov-Maxwell system is derived from an expression of Morrison and Pfirsch for the second variation of the free-energy of a steady state solution. (orig.).

13795 (IPP–6/295) **Discretization errors at free boundaries of the Grad-Schlueter-Shafranov equation.** Meyer-Spasche, R. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Fornberg, B. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Oct 1990. 41p. Order Number DE91754661. Source: OSTI; NTIS (US Sales Only); INIS.

The numerical error of standard finite-difference schemes is analyzed at free boundaries of the Grad-Schlueter-Shafranov equation of plasma physics. A simple correction strategy is devised to eliminate (to leading order) the errors which arise as the free boundary crosses the rectangular grid at irregular locations. The resulting scheme can be solved by Gauss-Newton or Inverse iterations, or by multigrid iterations. Extrapolation (from 2nd to 3rd order of accuracy) is possible for the new scheme. (orig.).

13796 (IPP–6/296) **Reflection and absorption of ordinary waves in an inhomogeneous plasma.** Croci, R. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Nov 1990. 21p. Order Number DE91754672. Source: OSTI; NTIS (US Sales Only); INIS.

This study treats the system of Vlasov and Maxwell equations for the Fourier transform in space and time of a plasma referred to Cartesian coordinates with the coordinate z parallel to the uniform equilibrium magnetic field with the equilibrium plasma density dependent on ηx, where η is a parameter. The k_y component of the wave vector is taken equal to zero, whereas k_z is different from zero. When the interaction of ordinary and extraordinary waves is neglected, the Fourier transform of the electric field of the ordinary waves obeys a homogeneous integral equation with principal part integrals, which is solved in the case of weak absorption and sufficiently small η (essentially smaller than vacuum wave vector), but without limitations on the ratio of the wavelength to the Larmor radius (the usual approximation being limited to wavelengths much smaller than the Larmor radius). The reflection and transmission coefficients and the total energy absorption are given in this approximation, whereas the energy conservation theorem for the reflection and transmission coefficients in an absorption-free plasma are derived for every value of η without explicit knowledge of the solutions. Finally, a general and compact equation for the eigenvalues which does not require complex analysis and knowledge of all solutions of the dispersion relation is given. (orig.).

13797 (IPP–I/255) **Characterisation of the angular momentum transport in ASDEX.** Kallenbach, A.; Mayer, H.M.; Fussmann, G.; Mertens, V.; Stroth, U.; Vollmer, O. ASDEX Team.

Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Oct 1990. 18p. Order Number DE91754667. Source: OSTI; NTIS (US Sales Only); INIS.

Angular momentum transport studies were conducted for nearly stationary situations of about 50 neutral-beam-heated ASDEX discharges under a variety of experimental conditions. Comparison of the confinement times of angular momentum and energy reveals close similarities between thermal and perpendicular momentum transport. Scaling laws are derived for the dependence of the central rotation speed, the momentum confinement time and the radially averaged momentum diffusivity from the main experimental parameters of L-mode discharges. The L-mode results are compared with the momentum transport behaviour during the improved confinement phase of H-mode, pellet-fuelled and counter-NI discharges. (orig.).

13798 (IPP–III/159) **Equilibrium and stability studies by the X-ray diagnostics in the W7-AS stellarator.** Lazaros, A.; Weller, A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Jun 1990. 21p. Order Number DE91754668. Source: OSTI; NTIS (US Sales Only); INIS.

X-ray multichord cameras with a choice of 24 slit filters are used in W7-AS to reproduce the radiation and the flux surface geometry. The steady-state line intensity profiles (which are obtained by smoothing the signal over a time interval) either confirm the calculated equilibrium configuration or (in the opposite case) are used to reconstruct the radiation configuration in which static islands have been observed. The fluctuating line intensity profiles (which are obtained by removing the steady-state part of the signal) are compared with simulated profiles, and the m = 2 mode is identified at the resonant iota value of 0.5. A correlation between the mode characteristics and the toroidal current is also established. (orig.).

13799 (JAERI-M–90-200) **The assembly and analysis of the ITER H-mode database in JFT-2M.** Matsuda, Toshiaki (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Miura, Yukitoshi; Suzuki, Norio; Mori, Masahiro; Tamai, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 33p. (In Japanese). Order Number DE91755671. Source: OSTI; NTIS (US Sales Only); INIS.

At the request of the ITER project, an H-mode confinement database was planned to be assembled. JFT-2M and 5 other tokamak teams, that are ASDEX, DIII-D, JET, PBX-M and PDX, have joined the plan and Dr. J.G. Cordey at JET has been coordinating. In JFT-2M, we selected over 200 H-mode shots and constructed the JFT-2M database on the basis of raw data and KAKO databank. Assembled database consists of over 3000 datapoints and 76 variables. A preliminary analysis of the database was done with the usage of the statistic analysis package SAS. Parameter dependences of the stored energy on main variables were investigated at the part of JFT-2M database and the results were applied to the full database to get a size scaling with the regression analysis. (author).

13800 (LRP–382/89) **Experimental study of the vertical stability of high decay index plasmas in the DIII-D tokamak.** Lister, J.B. (General Atomics, San Diego, CA (USA)); Lazarus, E.A.; Kellman, A.G. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1989. 57p. Order Number DE91623014. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments on the stabilization of highly elongated, vertically unstable plasmas were carried out on the DIII-D tokamak. Identification of the closed-loop transfer function showed that vertical stability could be usefully modelled as a second order dynamical system. The effect of varying the controller gains and the vertical field decay index was studied and found to be qualitatively as predicted by a low order model previously proposed. The implementation of a new hybrid inboard/outboard coil positional control with differing controller dynamics allowed operation of DIII-D up to 92% of the limiting equilibrium field decay index of the vacuum vessel for those plasmas used. This improved control has allowed operation at plasma elongation up to κ = 2.5. (author) 1 tab., 21 figs., 11 refs.

13801 (LRP–398/90) **Implementation of a multi-layer perception for a non-linear control problem.** Lister, J.B. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Schnurrenberger, H.; Marmillod, P. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1990. 45p. Order Number DE91623015. Source: OSTI; NTIS (US Sales Only); INIS.

We present the practical application of a 1-hidden-layer multilayer perception (MLP) to provide a non-linear continuous multi-variable mapping with 42 inputs and 13 outputs. The problem resolved is one of extracting information from experimental signals with a bandwidth of many kilohertz. We have an exact model of the inverse mapping of this problem, but we have no explicit form of the required forward mapping. This is the typical situation in data interpretation. The MLP was trained to provide this mapping by learning on 500 input-output examples. The success of the off-line solution to this problem using an MLP led us to examine the robustness of the MLP to different noise sources. We found that the MLP is more robust than an approximate linear mapping of the same problem. 12 bits of resolution in the weights are necessary to avoid a significant loss of precision. The practical implementation of large analog weight matrices using DAS-multipliers and a simple segmented sigmoid is also presented. A General Adaptive Recipe (GAR) for improving the performance of conventional back-propagation was developed. The GAR uses an adaptive step length and both the bias terms and the initial weight seeding are determined by the network size. The GAR was found to be robust and much faster than conventional back-propagation. (author) 20 figs., 1 tab., 15 refs.

13802 (LRP–411/90) **Invited and contributed papers presented at the joint Varenna-Lausanne international workshop on 'theory of fusion plasmas'.** Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Aug 1990. 57p. (CONF-900807–: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 27-31 Aug 1990). Order Number DE91003074. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers are indexed. (LW)

13803 (LRP–411/90, pp. 1-11) **Global external ideal magnetohydrodynamic instabilities in three-dimensional plasmas.** Cooper, W.A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Fu, G.Y.; Gruber, R.; Merazzi, S.; Schwenn, U.; Anderson, D.V. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Aug 1990. (CONF-900807–: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 27-31 Aug 1990). In *Invited and contributed papers presented at the joint Varenna-Lausanne international workshop on 'theory of fusion plasmas'.* 57p. Order Number DE91003074. Source: OSTI; NTIS (US Sales Only); INIS.

The global ideal MHD stability properties of the fully 3D standard ATF configuration with a bell-shaped pressure profile and a range of toroidal currents that flow in the outer part of the plasma column were investigated. The magnitude of the currents were very modest altering the rotational transform by ± 15% compared with the standard zero current case. Such small tailored currents could easily be produced with an ECRH current drive. Nevertheless, the MHD stability properties of the configuration were modified significantly. The zero current case has a β limit of 3.14% imposed by the n=1 family of modes. If the current imposed unwinds the externally applied transform, the stability properties deteriorate and the configuration is unstable below β = 1%. If the current winds the externally applied transform further, the n=1 family is stabilised and the n=2 family imposes a limit at β=4.25%. (author) 3 figs., 12 refs.

13804 (LRP–411/90, pp. 33-39) **Local absorption of linear electromagnetic waves in uniformly magnetized, inhomogeneous plasmas.** Jaun, A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Vaclavik, J. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Aug 1990. (CONF-900807–: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 27-31 Aug 1990). In *Invited and contributed papers*

presented at the joint Varenna-Lausanne international workshop on 'theory of fusion plasmas'. 57p. Order Number DE91003074. Source: OSTI; NTIS (US Sales Only); INIS.

A general expression for local power absorption of small amplitude electromagnetic fields in a hot, uniformly magnetized plasma is obtained starting from Vlasov-Maxwell equations. Using a transformation to Lagrangian coordinates, the power is calculated without introducing the flux due to particle streaming, and corresponds to the local exchange of energy between the wave and the plasma. Assuming the Larmor radii of the species to be small compared with the characteristic scale length of the fields and the equilibrium quantities such as density and temperature, an expansion to second order is carried out. This results in an explicit expression for local power absorption in a 2-D plasma, which takes into account the effects due to density and temperature gradients. (author) 5 refs.

13805 (LRP–411/90, pp. 41-57) **Analyses of Vlasov-Maxwell linear wave problems with large Larmor radii.** Sauter, O. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Vaclavik, J. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Aug 1990. (CONF-900807–: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 27-31 Aug 1990). In *Invited and contributed papers presented at the joint Varenna-Lausanne international workshop on 'theory of fusion plasmas'.* 57p. Order Number DE91003074. Source: OSTI; NTIS (US Sales Only); INIS.

The linearized Vlasov-Maxwell equations for an inhomogeneous bounded slab plasma have been derived without any assumption on the ratio of the Larmor radius to the fluctuation wavelength and inhomogeneity scale. Only Maxwellian equilibrium distribution function, slowly varying magnetostatic field B_0 and $k_y = 0$ have been assumed. In this case, the equations consist of three second order integro-differential equations for each component of the electric field. The first results of the code SEMAL, which solves these equations, are presented. They are compared with the results obtained with the code ISMENE, which solves these equations expanded to second order in the Larmor radii. Good agreement is found for the kinetic Alfven wave and a small shift in frequency is found for the surface mode of the fast magnetosonic wave. A formula for the local power absorption is also derived, which consists of a positive-definite term, due to resonant particles absorption, and a non-resonant term which can be of either sign. (author) 4 figs., 9 refs.

13806 (LRP–415/90) **MHD stability of an almost circular tokamak: Optimisation of the pressure and current profiles and influence of a point of reflection at the surface of the plasma.** Roy, A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)). Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Oct 1990. 162p. (In French). Order Number DE91622078. Source: OSTI; NTIS (US Sales Only); INIS.

In a tokamak, the ratio β between the plasma pressure and that of the magnetic field is limited by the appearance of instabilities. The magnetic field in a tokamak reactor will always be limited by technological constraints. It is therefore crucial to know what factors have an effect on the β limit, since a zero resistivity plasma fluid model allows for theoretical reproduction of the β limits observed experimentally. Theoretical studies have shown that the distributions of pressure and current density may have a substantial effect on the β limit. The effect of the current density and pressure distributions on the β limit has been studied for tokamak with a circular core section. The best results are obtained when the current density is concentrated in the centre of the section and is nil at the periphery. But the second region of stability against ballooning modes cannot be obtained in a circular tokamak owing to the destabilisation of the universal modes. This study was then extended to the stability of plasmas the section of which is almost circular and has a point of reflection. Such configurations are vital for fusion since they allow systems in which the confinement time does not deteriorate with an increase in the additional heating power. The β limit was calculated for different positions of the reflection point. The results show that when it is displaced from the interior towards the exterior of the torus, the stability of the overall modes is progressively improved until it is vertical. But if the point of reflection is further displaced from this vertical position towards the exterior of the torus, localised modes close to the edge of the plasma are destabilised and bring about a drop in the β limit. (author) figs., tabs., 80 refs.

13807 (LRP–420/90) **MHD modelling of density limit disruption in tokamaks.** Bondeson, A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Parker, R.; Hugon, M. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1990. 43p. Contract JW8-9007;final report, JET Article 14. Order Number DE91623017. Source: OSTI; NTIS (US Sales Only); INIS.

The magnetohydrodynamic (MHD) activity during density limit disruptions is modeled numerically by three-dimensional resistive reduced MHD simulations with a simple transport model and radiation losses. The simulations reproduce experimentally observed phenomena such as the destabilization of MHD modes near the plasma edge during the early profile contraction phase, followed by growth of the m=2/n=1 mode to large amplitude, a sequence of minor disruptions and the major disruption. A new theoretical model is given for the major disruption, which takes place in two phases: first, an internal relaxation flattens the temperature in the central part and subsequently, the current profile broadens. The internal instability of the first phase has a mainly m=1/n=1 displacement, but because of nonlinear coupling to the larger m=2/n=1 mode, the magnetic perturbation has a strong m=3/n=2 component. At a late stage of the internal relaxation, the large amplitude 2/1, 1/1, and 3/2 perturbations give rise to stochastic magnetic fields in the q=1 island, and at its end, the magnetic field is stochastic in the region $q \leq 2$. During the second phase, MHD turbulence develops on the stochasticized fields, resulting in filamentation and broadening of the current density, first in the central region. The disruption ends with a rapid instability of the $m \geq 2/n=1$ modes. The result is stochastic magnetic fields across the entire plasma and a large-scale broadening of the current profile. (author) 20 figs., 1 tab., 30 refs.

13808 (LRP–421/90) **Theory of plasma heating by low-frequency waves: magnetic pumping and Alfven resonance heating.** Vaclavik, J. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Appert, K. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1990. 180p. Order Number DE91623018. Source: OSTI; NTIS (US Sales Only); INIS.

The present status of the theory of plasma heating by low-frequency waves is reviewed from a unified point of view. (author) 18 figs., 195 refs.

13809 (SFB-191–90-A1-001) **The plasma-sheath transition in an asymmetric collisionless plasma.** Berg, H.P. van den (Bochum Univ. (Germany, F.R.). Inst. fuer Theoretische Physik 1); Riemann, K.U.; Ecker, G. Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 191 - Physikalische Grundlagen der Niedertemperaturplasmen. May 1990. 26p. Order Number DE91754663. Source: OSTI; NTIS (US Sales Only); INIS.

The plasma sheath problem ($\lambda_D \rightarrow 0$) for an asymmetric warm collision free plasma is solved in plane parallel geometry. To this end Emmert's model source term is generalized to account for a superimposed plasma drift. The quasineutral plasma approximation results in a system of coupled integral equations which can be solved analytically. In contrast to Emmert's symmetric model the upstream facing sheath edge shows the usual field singularity. At the downstream facing sheath edge we find a finite field strength and an oversatisfied Bohm criterion. These results are in full agreement with general considerations on the Bohm criterion and on the sheath edge field singularity. (orig.).

13810 (UCB/ERL-M–90/67) **Simultaneous potential and circuit solution for bounded plasma particle simulation codes.** Verboncoeur, J.P.; Alves, M.V.; Vahedi, V. California Univ., Berkeley, CA (USA). Electronics Research Lab. 7 Aug 1990. 21p.

Sponsored by U.S. Depar. DOE Contract FG03-86ER53220. Contract N00014-85-K-0809. Order Number DE91008959. Source: OSTI; NTIS; INIS; GPO Dep.

A second-order accurate method for solving the combined potential and circuit equations in an electrostatic bounded plasma PIC simulation is presented. The boundary conditions include surface charge on the electrodes, which are connected to a series RLC circuit with driving terms V(t) and I(t). The solution is obtained for planar, cylindrical, and spherical electrodes. The result is a tridiagonal matrix which is readily solved using well-known methods. The method is implemented in the codes PDP1 (Plasma Device Planar 1D), PDC1 (Cylindrical), and PDS1 (Spherical). 11 refs., 10 figs.

13811 (UCRL-ID–104566) **Some observations concerning alpha instabilities and driven tokamak reactors.** Fowler, T.K. (California Univ., Berkeley, CA (USA)). Lawrence Livermore National Lab., CA (USA). 16 Jul 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91008628. Source: OSTI; NTIS; INIS; GPO Dep.

While much research is needed to assess the reality and consequences of alpha-induced instabilities, crude transport estimates for the TAE mode indicate that as little as 10 percent of the alpha energy would be deposited in steady-state. Even so, CIT and the ITER technology phase would meet their minimal goals of Q = 5 if only the alphas themselves are ejected and not the fuel itself. Higher gain up to Q ~ 20 may be possible in driven reactors of a different design, depending on the effects of aspect ratio and other geometric features on confinement. Very high gain still requires alpha testing. 5 refs.

13812 (UCRL-ID–106603) **Spatial dependence of the sheath power transmission factor in DIII-D.** Futch, A.H. (Lawrence Livermore National Lab., CA (USA)); Hill, D.N.; Porter, G.D.; Matthews, G.F.; Buchenauer, D. Lawrence Livermore National Lab., CA (USA). Feb 1991. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009502. Source: OSTI; NTIS; INIS; GPO Dep.

The spatial dependence of the power transmission factor, d, associated with an ion-electron pair passing through the sheath at the DIII-D divertor plate has been determined by sweeping the edge plasma across Langmuir probe detectors. Our results show that d decreases from the classically expected value of eight near the low density edge of the scrape-off-layer plasma to values less than unity at the peak of the profile. 13 refs., 16 figs.

13813 (UCRL-JC–105124) **The Streamlined Darwin Field method (and a solution technique that makes it practical).** Hewett, D.W.; Larson, D.J.; Doss, S. Lawrence Livermore National Lab., CA (USA). 26 Oct 1990. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9011127–17: 32. annual meeting of the American Physical Society - Division of Plasma Physics (APS/DPP); US-Japan workshop on advances in simulation techniques applied to plasmas and fusion, Cincinnati, OH (USA); Los Angeles, CA (USA), 12-16 Nov 199 Order Number DE91009482. Source: OSTI; NTIS; GPO Dep.

The new Streamlined Darwin Field (SDF) model eliminates some Boundary Conditions (BCs) in which plasma-wall boundaries play a significant role in plasma behavior. The new formulation trades difficult BC issues for strongly coupled 2nd-order partial differential equations. We apply a particular version of ADI called Dynamic ADI (DADI) to this set of equations that is sufficiently fast to make solution of the SDF model practical in an initial-value PIC code.

13814 (UCRL-JC–105616) **Recent developments in Monte Carlo techniques.** Zimmerman, G.B. Lawrence Livermore National Lab., CA (USA). 28 Nov 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9011149–15: 1990 nuclear explosives code developers' conference, Monterey, CA (USA), 6-9 Nov 1990). Order Number DE91009750. Source: OSTI; NTIS; GPO Dep.

Many aspects of the using Monte Carlo methods to transport particles in complex geometries are explored. The thermonuclear source of particles is presented as a Monte Carlo simulation of the reaction process. Corrections due to both bulk and thermal Doppler motion are described as are detailed general purpose formulas for the stopping of charged particles. In heterogeneous materials characterized by binary Markovian statistics models are presented for the effects on both thermal and Monte Carlo transport. It is found that the effects of angular Coulomb scattering must be included in models of charged particle transport through heterogeneous materials. 9 refs., 2 figs.

13815 (UCRL-JC–105829) **30+ years of plasma simulation.** Langdon, B. Lawrence Livermore National Lab., CA (USA). 19 Dec 1990. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9009337–2: International Dawson symposium on the physics of plasma, Los Angeles, CA (USA), 24-25 Sep 1990). Order Number DE91009478. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. PLASMA SIMULATION/historical aspects; COMPUTER ARCHITECTURE

13816 (UCRL-JC–106408) **A new weighted residual finite element method for computational electromagnetics in the time domain.** Ambrosiano, J.J. (Lawrence Livermore National Lab., CA (USA)); Brandon, S.T.; Loehner, R. Lawrence Livermore National Lab., CA (USA). 4 Feb 1991. 14p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9103123–3: 7. annual review of progress in applied computational electromagnetics, Monterey, CA (USA), 19-21 Mar 1991). Order Number DE91008741. Source: OSTI; NTIS; GPO Dep.

Engineers and scientists have become increasingly interested in calculating electromagnetic effects in the time domain. For example, the time domain is especially convenient for studying short (wide band) pulses. For such methods to be generally useful, they must be free of the severe geometric restrictions imposed by traditional finite difference methods. In our research into methods for plasma simulations in realistic geometries, we have developed finite element methods for electromagnetics in the time domain on unstructured grids. Unstructured grids provide maximum flexibility in fitting sample points to the problem, both on boundaries and in the interior. Finite elements provide the most convenient framework for the mathematics as well as for the implementation. We will present a new finite element method for computational electromagnetics on unstructured grids. The method is fast, easy to implement, and 2nd-order accurate. Although we use low-order elements, the method can be shown to preserve the divergence constraints ($\nabla \cdot B = 0$, $\nabla \cdot E = 0$ in vacuum). We also present a numerical benchmark. 11 refs., 3 figs.

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Refer also to citation(s) 13057, 13058, 13212, 13903, 13906

13817 (ANL/CP–70535) **LOCA analysis for manganese-stabilized steel.** Attaya, H. Argonne National Lab., IL (USA). Sep 1990. 7p. Sponsored by USDOE,. DOE Contract W-31109-ENG-38. (CONF-901007–62: 9. topical meeting on technology of fusion energy, Oak Brook, IL (USA), 7-11 Oct 1990). Order Number DE91008809. Source: OSTI; NTIS; INIS; GPO Dep.

Manganese-stabilized steels have been proposed as candidate structural materials for fusion reactors, because they have been perceived as "low-activation" materials. Depending on the neutron spectra and the neutron fluence, the decay heat in Mn-stabilized steels is about 3–7 times larger than that in the Ni-stabilized steels. This large amount of decay heat could have serious impact in the case of loss of coolant accident (LOCA). A two-dimensional LOCA model has been used to examine the LOCA temperature response of the manganese steel when utilized in an earlier US design of ITER. The results show that the Mn-steel has approached its melting temperature by less than 100°C after about 7 hours from the onset of LOCA. On the other hand, the results for the nickel stabilized steel alloy 316SS show that the maximum temperature reached is 532°C in about the same time. 14 refs., 13 figs., 2 tabs.

13818 (CEA-N–2644) **Tritium tasks for the net fusion technology program.** Hircq, B. CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France). 1990. 312p. Order Number DE91752733. Source: OSTI; NTIS (US Sales Only).

Six Tritium Technology tasks have been undertaken in the BRUYERES-LE-CHATEL Research Center of the French Atomic

Energy Commission, in June 1986, as part of the NET Tritium Technology Program. Four of these six studies concern the torus exhaust gas purification and two of them are more specific of the involved materials. In 1988, the studies themselves have begun and the objective of this document is to indicate, for each task, the main results which have been obtained during the period 1988-89, for allowing a global valuation of the progress state as well as an anticipation for carrying out the works.

13819 (CONF-870570–22) **ICH antenna development on the ORNL RF Test Facility.** Gardner, W.L.; Bigelow, T.S.; Haste, G.R.; Hoffman, D.J.; Livesey, R.L. Oak Ridge National Lab., TN (USA). [1987]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL (USA); 4-6 May 1987. Order Number DE91009654. Source: OSTI; NTIS; INIS; GPO Dep.

A compact resonant loop antenna is installed on the ORNL Radio Frequency Test Facility (RFTF). Facility characteristics include a steady-state magnetic field of $\approx$ 0.5 T at the antenna, microwave-generated plasmas with $n_e \approx 10^{12}$ cm^{-3} and $T_e \approx 8$ eV, and 100 kW of 25-MHz rf power. The antenna is tunable from ~22–75 MHz, is designed to handle $\geq$1 MW of rf power, and can be moved 5 cm with respect to the port flange. Antenna characteristics reported and discussed include the effect of magnetic field on rf voltage breakdown at the capacitor, the effects of magnetic field and plasma on rf voltage breakdown between the radiating element and the Faraday shield, the effects of graphite on Faraday shield losses, and the efficiency of coupling to the plasma. 2 refs., 4 figs.

13820 (CONF-871007–140) **ORNL compact loop antenna design for TFTR and Tore Supra.** Taylor, D.J. (Oak Ridge National Lab., TN (USA)); Baity, F.W.; Bryan, W.E.; Hoffman, D.J.; McIlwain, R.L.; Ray, J.M. Oak Ridge National Lab., TN (USA). [1987]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 12. symposium on fusion engineering; Monterey, CA (USA); 12-16 Oct 1987. Order Number DE91009649. Source: OSTI; NTIS; INIS; GPO Dep.

The goal supplemental ion cyclotron resonance heating (ICRH) of fusion plasma is to deliver power at high efficiencies deep within the plasma. The technology for fast-wave ICRH has reached the point of requiring "proof-of-performance" demonstration of specific antenna configurations of specific antenna configurations and their mechanical adequacy for operating in a fusion environment. Oak Ridge National Laboratory (ORNL) has developed the compact loop antenna concept based on a resonant double loop (RDL) configuration for use in both Tokamak Fusion Test Reactor (TFTR) and the Tore Supra ICRH programs. A description and a comparison of the technologies developed in the two designs are presented. The electrical circuit and the mechanical philosophy employed are the same for both antennas, but different operating environments result in substantial differences in the design of specific components. The ORNL TFTR antenna is designed to deliver 4 MW over a 2-s pulse, and the ORNL Tore Supra antenna is designed for 4 MW and essentially steady-state conditions. The TFTR design embodies the first operations compact RDL antenna, and the Tore Supra antenna extends the technology to an operational duty cycle consistent with reactor-relevant applications. 7 refs., 5 figs.

13821 (CONF-901025–32) **Comparison of beryllium and graphite first-walls in JET.** Thomas, P.R. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 10p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/A-5-3). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005489. Source: OSTI; NTIS; INIS; GPO Dep.

JET has operated with beryllium as a first-wall material in 1989 and 1990. An initial period with beryllium evaporation onto the original graphite surfaces was followed by operation with beryllium belt-limiter tiles. Beryllium Faraday shields for the ICRH antennae and lower X-point target tiles were installed for experiments in 1990. The use of beryllium has increased the density limit, significantly reduced deconditioning following disruptions, allowed heavy gas fueling for impurity control, reduced the impurity influx from the ICRH antennae so that ICRH-only H modes were possible for the first time and permitted hot-ion plasmas on the outer limiters. This paper describes the primary effects of beryllium which led to these improvements in performance. 11 refs., 3 figs.

13822 (CONF-901025–34) **High density regimes and beta limits in JET.** Smeulders, P. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 10p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/A-3-4). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005490. Source: OSTI; NTIS; INIS; GPO Dep.

Results are first presented on the density limit in JET discharges with graphite (C), Be gettered graphite and Be limiters. There is a clear improvement in the case of Be limiters. The Be gettered phase showed no increase in the gas fueled density limit, except with Ion Cyclotron Resonance Heating (ICRH), but, the limit changed character. During MARFE-formation, any further increase in density was prevented, leading to a soft density limit. The soft density limit was a function of input power and impurity content with a week dependence on q. Helium and pellet fuelled discharges exceeded the gas-fuelled global density limits, but essentially had the same edge limit. In the second part, results are presented of high β operation in low-B Double-Null (DN) X-point configurations with Be-gettered carbon target plates. The Troyon limit was reached during H-mode discharges and toroidal β values of 5.5% were obtained. At high beta, the sawteeth were modified and characterised by very rapid heat-waves and fishbone-like pre- and post-cursors with strongly ballooning character. 17 refs., 5 figs.

13823 (CONF-901025–37) **Recent JET results and future prospects.** Rebut, P.H. The JET Team. JET Joint Undertaking, Abingdon (UK). [1990]. 22p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. (IAEA-CN–53/A-1-2). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE91005474. Source: OSTI; NTIS; INIS; GPO Dep.

The latest results of JET plasmas in transient and steady states are presented. Substantial improvements in plasma purity and corresponding reductions in plasma dilution have resulted from the use of beryllium as the first wall material facing the hot plasma. As a consequence, plasmas with a fusion triple product ($n_D(0)\tau_E T_i(0)$) in the range 8–9 $\times$ 10^{20} m^{-3} skeV have been achieved (within a factor of 8 that required in a fusion reactor), albeit under transient conditions. The general JET performance has also improved, allowing the parameters of a reactor plasma to be individually achieved in JET. In view of their importance for reactors, the JET results are presented with particular emphasis on their significance for the formulation of a plasma model for the Next Step. However, impurity influxes limit the attainment of better parameters and prevent the realization of steady state conditions at high heating powers. To address these problems of impurity control, plasma fueling and helium ash exhaust, a New Phase is planned for JET. An axisymmetric pumped divertor configuration will allow operating conditions close to those of a reactor. The divertor configuration should demonstrate a concept of impurity control and determine the size and geometry needed to fulfill this concept in a reactor. It should identify appropriate materials for plasma facing components and define the operational domain for the Next Step.

13824 (CONF-901248–2) **Experimental development of a millimeter wave free electron laser.** Radack, D.J.; Bidwell, S.W.; Antonsen, T.M. Jr.; Carmel, Y.; Destler, W.W.; Granatstein, V.L.; Latham, P.E.; Levush, B.; Mayergoyz, I.D.; Rodgers, J.; Zhang, Z.X. Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. [1990]. 4p. Sponsored by USDOE,. DOE Contract FG05-87ER52147. From 15. international conference on infrared and millimeter waves; Lake Buena Vista, FL (USA); 10-14 Dec 1990. Order Number DE91008318. Source: OSTI; NTIS; INIS; GPO Dep.

A 1 MW (cw), millimeter wave FEL ($\lambda_3 \sim$ 0.5 mm)is currently under development with an application for heating fusion plasmas. Two salient features of the FEL are the use of a short-period wiggler $\ell_w \leq$ 10 mm electromagnet and a mildly relativistic ($E_{beam} \leq$ 1 MeV) sheet electron beam. The FEL has been designed to operate in the high-gain regime and uses a tapered wiggler. The wiggler provides beam focusing as well as the magnetostatic pump wave. The effectiveness of wiggler focusing is being investigated.

Planned experiments will address the critical issues of beam interception and stable single-mode operation. 12 refs., 1 tab.

13825 (CONF-9009166–19) **A high-average power tapered FEL amplifier at submillimeter frequencies using sheet electron beams and short-period wigglers.** Bidwell, S.W.; Radack, D.J.; Antonsen, T.M. Jr.; Booske, J.H.; Carmel, Y.; Destler, W.W.; Granatstein, V.L.; Levush, B.; Latham, P.E.; Zhang, Z.X. Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. [1990]. 15p. Sponsored by USDOE,. DOE Contract FG05-87ER52147. From 12. international free electron laser conference (FEL-12); Paris (France); 17-21 Sep 1990. Order Number DE91008319. Source: OSTI; NTIS; INIS; GPO Dep.

A high-average-power FEL amplifier operating at submillimeter frequencies is under development at the University of Maryland. Program goals are to produce a CW, ~1 MW, FEL amplifier source at frequencies between 280 GHz and 560 GHz. To this end, a high-gain, high-efficiency, tapered FEL amplifier using a sheet electron beam and a short-period (superconducting) wiggler has been chosen. Development of this amplifier is progressing in three stages: (1) beam propagation through a long length (~1 m) of short period (λ_w = 1 cm) wiggler, (2) demonstration of a proof-of-principle amplifier experiment at 98 GHz, and (3) designs of a superconducting tapered FEL amplifier meeting the ultimate design goal specifications. 17 refs., 1 fig., 1 tab.

13826 (DOE/ER/18862–2) **A 1.5–4 Kelvin detachable cold-sample transfer system: Application to inertially confined fusion with spin-polarized hydrogens fuels.** Alexander, N.; Barden, J.; Fan, Q.; Honig, A. Syracuse Univ., NY (USA). Dept. of Physics. [1990]. 32p. Sponsored by USDOE,. DOE Contract FG03-91ER18862 ;FC03-85DP40200 ;FG03-90SF18437. Order Number DE91007763. Source: OSTI; NTIS; INIS; GPO Dep.

A compact cold-transfer apparatus for engaging and retrieving samples at liquid helium temperatures (1.5–4K), maintaining the samples at such temperatures for periods of hours, and subsequently inserting them in diverse apparatuses followed by disengagement, is described. The properties of several thermal radiation-insulating shrouds, necessary for very low sample temperatures, are presented. The immediate intended application is transportable target-shells containing highly spin-polarized deuterons in solid HD or D_2 for inertially confined fusion (ICF) experiments. The system is also valuable for unpolarized high-density fusion fuels, as well as for other applications which are discussed. 9 refs., 6 figs.

13827 (DOE/ER/52147–4) **Microwave generation for magnetic fusion energy applications: Progress report, September 15, 1990–September 14, 1991.** Antonsen, T.M. Jr.; Destler, W.W.; Granatstein, V.L.; Levush, B.; Mayergoyz, I.D. Maryland Univ., College Park, MD (USA). Jan 1991. 45p. Sponsored by USDOE,. DOE Contract FG05-87ER52147. Order Number DE91008280. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report encompasses work on three separate projects, all related to developing sources for electron cyclotron resonance heating of magnetic fusion plasmas. The report is therefore divided into three parts as follows: free electron lasers with small period wigglers; theory and modeling of high frequency, high power gyrotron operation; and depressed collectors for energy recovery in gyrotrons. Task A is experimental and eventually aims at developing CW sources for ECRH at frequencies as high as 600 GHz. Task B provides gyrotron theory and modeling in support of the gyrotron development programs at MIT and Varian. Task C was phased out in the current contract year but recent publications are included in this report in order to create a permanent record for the use of future researchers with interest in the topic of increasing gyrotron efficiency through the use of depressed collectors.

13828 (DOE/SF/18438–1) **Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets: Final report, December 13, 1989–February 13, 1991.** Griem, H.R.; Moreno, J. Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. Mar 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-90SF18438. Order Number DE91009378. Source: OSTI; NTIS; GPO Dep.

In experiments this past year at the University of Rochester's Laboratory for Laser Energetics we obtained time-integrated and time-resolved spectra from the ultraviolet to the x-ray region. We have investigated various phenomena in laser-produced plasmas including spectral line broadening, plasma expansion velocities, ionization and recombination of low-Z materials in spherical targets, and the formation of satellites near some resonance lines. In addition we have improved our spectroscopic instrumentation.

13829 (ETDE-IT–91-08) **3-D Monte Carlo analyses of shielding system in tokamak fusion reactor.** Gallina, M.; Petrizzi, L.; Rado, V. ENEA, Frascati (Italy). Centro Ricerche Energia. Sep 1990. 11p. (CONF-900970–5: International conference on Monte Carlo methods in neutron and photon transport, Budapest (Hungary), 25-28 Sep 1990). Order Number DE91752904. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at international conference on Monte Carlo methods for neutron and photon transport calculations (Budapest, 25-28 Sep 1990).

Within the framework of the ITER (International Tokamak Experimental Reactor) design program, 3D neutronics calculations were carried out to assess system shielding performances in the basic machine configuration by means of the Monte Carlo Neutron Photon (MCNP) code (3-B version). The main issue concerns the estimation of the nuclear heat and radiation loads on the toroidal field superconducting coils. 'Self generated weight windows' (w.w.) and source biasing techniques were used to treat the deep penetration through the bulk shield and streaming through the system gaps and openings. The main results are reported together with a discussion of the computing methods, especially of the variance reduction techniques adopted.

13830 (ETDE-IT–91-12) **Neutron irradiation of candidate ceramic breeder materials of fusion reactors: Gamma spectrometry of activation nuclides and evaluation of tritium produced by (n, alpha) reaction on Li-6.** Carconi, P.L.; Casadio, S.; Moauro, A. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettoriali di Base. Oct 1990. 18p. (CONF-9010328–1: International conference on activation analysis and its applications, Beijing (China), 15 Oct 1990). Order Number DE91752902. Source: OSTI; NTIS (US Sales Only); INIS.

Paper presented at international conference on activation analysis and its application (Beijing, 15-19 Oct 1990).

In the context of the European programs for the future fusion reactors, the Process Chemistry Dept. of ENEA (Italian Commission for Alternative Energy Sources), Casaccia (Italy), has been involved in preparing ceramic blanket materials as tritium breeders; special consideration has been addressed to the nuclear characterization of $LiAlO_2$ and Li_2ZrO_3. This paper reports: (a) the results of neutron irradiation of ceramic specimens in the TRIGA reactor and gamma spectrometry measurements for neutron activation analysis purposes; (b) the results of isothermal annealing of the irradiated samples and tritium extraction, by using an 'out of pile' system.

13831 (ETDE-IT–91-14) **Quality of illumination for spherical capsule enclosed in radiating cavity.** Caruso, A.; Strangio, C. ENEA, Frascati (Italy). Centro Ricerche Energia. 1990. 31p. Order Number DE91752927. Source: OSTI; NTIS (US Sales Only); INIS.

The implosion of spherical capsules by the incoherent X-rays emitted from surrounding hot high-Z walls seems to be a scheme relevant to inertial confinement fusion. In this paper, the quality of illumination for a spherical capsule enclosed in a axisymmetric radiating cavity is considered for the two extreme cases of given, (optically) thick or thin, non-uniform, emitting cavity surface layer. If the specific intensity on the radiating surface is represented by an expansion in Legendre polynomials, it is found, for spherical radiating cavities, that the n-term contribution to the power density upon the capsule factorizes as the product of a function of the position on the capsule surface, times a function f(n,x) of its radius x. Furthermore it is found that values of x may exist for which f(n,x)=0, this being true both for thick and thin modeling, with values of x almost the same. Simple criteria to get a given degree of uniformity are suggested. The effects of the cavity shape on the illumination quality have also been studied as a function of the cavity aspect ratio for spherical capsules enclosed in ellipsoidal cavities (oblate or prolate).

13832 (GA-A–20280) **Divertor-plasma studies on DIII-D.** Hill, D.N (Lawrence Livermore National Lab., CA (USA)); Futch, A.; Porter, G.; Rensink, M.E.; Rognlien, T.; Petrie, T.W.; Jackson, G.L.; La Haye, R.; Leikind, B.; Lippmann, S.; Mahdavi, M.A.; Schaffer, M.; Staebler, G.M.; Wong, C.; Brooks, J.N.; Buchenauer-General Atomics, San Diego, CA (USA). Nov 1990. 18p. Sponsored by USDOE,. DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC04-76DP00789 ;AC05-84OR21400 ;FG03-89ER51121. (CONF-901025–43: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990; IAEA-CN–53/G-1-3). Order Number DE91008923. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents an overview of recent results from divertor physics studies in DIII-D. Heat flux measurements at input power levels up to 20 MW show that steady divertor heat loads of up to 4 MW/m^2 are obtained in H-mode discharges with ELMs. No carbon blooms are observed. The heat flux profile is highly peaked at the outside strike point in single-null discharges, and is up/down asymmetric in double-null discharges. Recent experiments with gas injection below the X-point have demonstrated a factor of two reduction in the peak divertor heat flux for H-mode plasmas at these power levels. These heat flux data, along with measurements of the n_e and T_e profiles at the divertor are being used to help interpret the first reported measurements of the erosion profile for a set of graphite divertor tiles exposed to several months of high power tokamak operation. We have now modified the divertor hardware in order to carry out experiments with divertor biasing, baffling, and pumping. 26 refs., 8 figs.

13833 (GA-A–20299) **Latest results from DIII-D and their implications for future devices.** Colleraine, A.P.; Luxon, J.L. General Atomics, San Diego, CA (USA). Feb 1991. 13p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. (CONF-901007–61: 9. topical meeting on technology of fusion energy, Oak Brook, IL (USA), 7-11 Oct 1990). Order Number DE91008499. Source: OSTI; NTIS; INIS; GPO Dep.

The DIII-D Tokamak has become one of the major sources of physics and technology data for the design of future large machines such as ITER and CIT. In large part this is because of its extremely flexible design and the ability to run tests or add new diagnostic devices with a minimum of down-time and expense. Fundamental plasma physics studies are still the major focus of our experimental program, but increasingly, we are looking at new ways to answer the complex fusion technology questions emerging from the design studies for the next-generation devices. Recent results have demonstrated world record beta plasmas, long quiescent H-mode operation, partial noninductive current drive using both neutral beam and rf power injection, single- and double-null divertor operation, and divertor particle- and heat-load management. The recently installed Advanced Divertor hardware will allow critical transport experiments to be run with independent control of the density. It will also permit the concept of dc helicity injection current drive to be tested. This paper summarizes our most important recent findings and also outlines a few of the many interesting problems that are now under study to address fusion technology questions. 26 refs., 10 figs.

13834 (GA-A–20317) **Divertor baffling and biasing experiments on DIII-D.** Ali Mahdavi, M. (General Atomics, San Diego, CA (USA)); Schaffer, M.; Anderson, P.; Baxi, C.; Jackson, G.L.; Kellman, A.G.; Leikind, B.; Lippmann, S.; Luxon, J.; Osborne, T.; Peterson, P.; Reis, E.; Scoville, J.T.; Smith, J.; Staebler, G.M.; Stambaugh, R.;General Atomics, San Diego, CA (USA). Nov 1990. 10p. Sponsored by USDOE,. DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC04-76DP00789 ;AC05-84OR21400 ;FG03-89ER51121. (CONF-901025–45: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990). Order Number DE91008920. Source: OSTI; NTIS; INIS; GPO Dep.

First results of divertor baffling and biasing experiments in Ohmic and low power beam-heated plasmas using the DIII-D Advanced Divertor are reported. The Advanced Divertor commissioned recently is designed to study baffling, plasma biasing, and dc helicity injection current drive. Using this unique baffle configuration in Ohmic and low powered beam-heated plasmas, we have obtained pressures under the baffle in excess of 5 mTorr and driven a poloidal scrape-off layer current in excess of 4 kA. Pressure under the baffle is strongly influenced by biasing. With the $E_r \times B$ drift in the direction of the baffle throat, the pressure under the baffle can be a factor of five higher than with the opposite polarity. Biasing increases the level of divertor region magnetic fluctuations. 11 refs., 4 figs.

13835 (GA-A–20330) **Nuclear data needs for fusion programs.** Cheng, E.T. (TSI Research, Solana Beach, CA (USA)). General Atomics, San Diego, CA (USA). Feb 1991. 14p. Sponsored by USDOE,. DOE Contract AC03-89ER52153. (CONF-900814–17: 7. ASTM-EURATOM symposium on reactor dosimetry, Strasbourg (France), 27-31 Aug 1990). Order Number DE91008498. Source: OSTI; NTIS; INIS; GPO Dep.

A review is given in areas relevant to nuclear data needs for fusion programs. These areas address the motivation and direction of fusion nuclear data development activities and include fusion fuel cycles, nuclear data needs, low activation fusion motivations, and progress on fusion nuclear data development activities. A list of important activation cross sections is presented whose measured data are needed to help assess some fusion reactor design issues. 11 refs.

13836 (GA-A–20371) **Thermal analysis of JET cryopump nitrogen shield.** Baxi, C.B. General Atomics, San Diego, CA (USA). Feb 1991. 40p. Sponsored by USDOE,. DOE Contract AC03-89ER51114. Order Number DE91008408. Source: OSTI; NTIS; INIS; GPO Dep.

This work was performed under the collaborative program between DIII-D ADP cryopump and JET pumped divertor. The purpose of the analysis was to reduce the uncertainty in the JET cryopump design by using thermal hydraulic methods developed at GA for DIII-D cryopump. The reference design of JET cryopump nitrogen shield consists of a parallel flow arrangement. This arrangement was selected due to concern about conduction between warm and cold parts of the shield during cool down transients. Such a parallel flow arrangement in two phase flow may be unstable. Hence, an analysis was undertaken to investigate the conduction effects in the shield for this and other flow arrangements. Thermal analysis was done by a finite element program developed at GA. In this analysis, three flow arrangements were developed for cool down from 300°K to about 80°K. In order to simplify the analysis, coolant was assumed to be a N_2gas at an inlet temperature of 80°K.

13837 (IAEA-TECDOC–558, pp. 397-400) **Magnetic surface measurement in CHS.** Yamada, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). CHS Group. International Atomic Energy Agency, Vienna (Austria). Jul 1990. (CONF-890403–: 7. international workshop on stellarators, Oak Ridge, TN (USA), 10-14 Apr 1989). In *Stellarator physics: Proceedings of the seventh international workshop on stellarators, held in Oak Ridge, Tennessee, 10-14 April 1989.* 635p. Order Number DE91613178. Source: OSTI; NTIS (US Sales Only); INIS.

The magnetic-field-mapping experiment has been done in CHS. Closed magnetic surfaces have been successfully confirmed up to 95% of the expected outermost surface and coincided with computed ones within the experimental resolution. Magnetic-island structures seen at the major rational surface (ι-bar = 1/3, 1/2, and 2/3) tend to shrink with the increase of B_t. The experimental results and the computed analyses consistently explain that the error field is the ambient field due to magnetization of the building structure. The m = 2 island width is estimated around 5 mm in ECH experiment at B_t = 1T. (author). 4 refs, 3 figs.

13838 (INDC(NDS)–241/LF) **First results of FENDL-1 testing and start of FENDL-2: Summary report of a consultants' meeting, held in Vienna, Austria, 25-28 June 1990.** Pashchenko, A.B.; Muir, D.W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Nov 1990. 49p. (CONF-9006319–: IAEA consultants meeting on first results of Fusion Evaluated Nuclear Data Library (FENDL-1) testing and start of FENDL-2, Vienna (Austria), 25-28 Jun 1990). Order Number DE91623022. Source: OSTI; NTIS (US Sales Only); INIS.

The present report contains the summary of the IAEA Consultants' Meeting on "First Results of FENDL-1 Testing and Start of FENDL-2". The meeting conclusions and recommendations and future plans for the development of a nuclear data base for fusion reactor technology are included in this summary report. (author). 4 tabs.

13839 (INIS-mf–12722, pp. 284-298) **Small specimen test technique for mechanical properties evaluation.** Takahashi, Hideaki (Tohoku Univ., Sendai (Japan). Research Inst. for Strength and Fracture of Materials). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1989. 346p. (CONF-8901207–: JAERI symposium on high energy neutron source for material research and development. Tokyo (Japan), 12-13 Jan 1989). In *High energy neutron source for material research and development: Report on JAERI symposium.* Order Number DE91713086. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes present status of small specimen test technology for fusion reactor structural materials development. Main topics are focused to the development of miniaturized small punch test to extract fracture strain and strength information from both 10 mm square plate specimen with 0.5 mm thickness and TEM disc specimen as small as 3 mm diameter and 0.25 mm in thickness. A draft of recommended practice for small punch (SP) test is demonstrated, which covers determination of fracture toughness characteristics of metallic materials such as ductile to brittle transition temperature (SPDBTT) and elastic-plastic fracture toughness (J_{ICSP}) using miniaturized SP specimens. Some recent information on post-irradiation SP experiment and stress corrosion cracking SP test is also given. (author).

13840 (IPP–2/310) **Studies on normal-conducting coils for Wendelstein VII-X.** Harmeyer, E.; Kisslinger, J.; Rau, F.; Sapper, J.; Wobig, H. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Aug 1990. 22p. Order Number DE91754671. Source: OSTI; NTIS (US Sales Only); INIS.

For Wendelstein VII-X, the next step stellarator experiment at IPP Garching, a Helias configuration has been chosen. The goals of Wendelstein VII-X are to continue the development of the modular stellarator and to demonstrate the reactor capability of this stellarator line. The main data of the selected HS5-10 configuration with five field periods are: major radius R_0 = 5.5 m, magnetic induction B_0 = 3 T and stored magnetic energy W $\simeq$ 0.6 GJ. For comparison with the superconducting coil system which is foreseen for Wendelstein VII-X, a pulsed water-cooled normal-conducting version has been designed in order to explore the limitations and restrictions of this approach. Limitations are the high ohmic power dissipated in the coils and the electric energy currently available at IPP. Normal-conducting coils would allow to apply the well-known techniques in manufactoring these coils, as successful in use in the Wendelstein VII-AS experiment. But these techniques are applicable also for the conductor proposed for the superconducting coils of Wendelstein VII-X. In this report the time-dependent current and resistance of the coil system circuit is considered; the electric power needed, the total dissipated energy, and the temperature rise of the coil copper is calculated. Scaling laws are derived and parameter studies are made by varying the geometrical dimensions of the system. (orig.).

13841 (IPP–III/167) **Combined operation of pellet injection and lower hybrid current drive on ASDEX.** Soeldner, F.X. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Mertens, V.; Bosch, H.S.; Kornherr, M.; Lang, R.; Leuterer, F.; Loch, R.; Sandmann, W.; Bartiromo, R.; Ushigusa, K. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Oct 1990. 23p. Order Number DE91754670. Source: OSTI; NTIS (US Sales Only); INIS.

Simultaneous operation of Lower Hybrid-current drive and pellet injection could be successfully achieved. With peripheral ablation of the pellets by suprathermal electrons, the same net inward flux of particles is found as with deep penetration of pellets into ohmically heated plasmas. The density profile $n_e(r)$ peaks with the same increment of the peaking factor $Q_n = n_{ec}/\langle n_e \rangle$ in both cases. The global energy confinement time rises with density, $\tau_E \propto$ anti n_e, in the combined operation. (orig.).

13842 (Juel–2371) **A comparison of tokamak operation with metallic getters (Ti, Cr, Be) and boronization.** Winter, J. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Plasmaphysik. Jul 1990. 64p. Order Number DE91754660. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to discharge cleaning techniques, gettering of tokamaks has been used since 1975 as a powerful tool for controlling the impurity influx into fusion plasmas. High-Z metals like Ti and Cr, evaporated onto the walls of the fusion devices, have first been used. After the introduction of carbon as low Z plasma facing material for the large tokamaks new scenarios were developed, optimizing the low-Z aspect of wall materials. These are the boronization technique and the evaporation of Be in conjunction with the use of Be limiters. A review of the different getter techniques and of the observed results will be given, focussing on the comparison of the tokamak performance achieved with boronization and the use of beryllium. It is shown that in all cases of gettering the most important mechanism for the improved machine performance is the control of the oxygen impurity influx. Very similar results are found for the impurity control potential. The added benefit of boronization and Be gettering arises from the low Z of the materials. Both scenarios essentially lead to the same machine performance. Both render themselves as an option for future devices. (orig.).

13843 (Juel–2378) **Radiation control in a limiter tokamak.** Samm, U. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Plasmaphysik. Aug 1990. 32p. (CONF-9005324–: Satellite workshop of the 9th PSI conference, Cadarache (France), 28-30 May 1990). Order Number DE91754664. Source: OSTI; NTIS (US Sales Only); INIS.

The requirements for radiation cooling in a tokamak are discussed and experimental evidence for a plasma with a cold radiating boundary - the detached plasma - is presented as an example. The radiation characteristics is analyzed and, in particular, the non-coronal conditions at the plasma boundary are considered by introducing the radiation potential in order to express the radiation in terms of impurity fluxes rather than in densities. The possibilities for radiation control by intrinsic and injected impurities are examined and some experimental examples are presented. (orig.).

13844 (KFK–4785) **NET remote workstation.** Leinemann, K. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorentwicklung (IRE); Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. Oct 1990. 162p. Order Number DE91759269. Source: OSTI; NTIS (US Sales Only); INIS.

The goal of this NET study was to define the functionality of a remote handling workstation and its hardware and software architecture. The remote handling workstation has to fulfill two basic functions: (1) to provide the man-machine interface (MMI), that means the interface to the control system of the maintenance equipment and to the working environment (telepresence) and (2) to provide high level (task level) supporting functions (software tools) during the maintenance work and in the preparation phase. Concerning the man-machine interface, an important module of the remote handling workstation besides the standard components of man-machine interfacing is a module for graphical scene presentation supplementing viewing by TV. The technique of integrated viewing is well known from JET BOOM and TARM control using the GBsim and KISMET software. For integration of equipment dependent MMI functions the remote handling workstation provides a special software module interface. Task level support of the operator is based on (1) spatial (geometric/kinematic) models, (2) remote handling procedure models, and (3) functional models of the equipment. These models and the related simulation modules are used for planning, programming, execution monitoring, and training. The workstation provides an intelligent handbook guiding the operator through planned procedures illustrated by animated graphical sequences. For unplanned situations decision aids are available. A central point of the architectural design was to guarantee a high flexibility with respect to hardware and software. Therefore the remote handling workstation is designed as an open system based on widely accepted standards allowing the stepwise integration of

the various modules starting with the basic MMI and the spatial simulation as standard components. (orig./HP).

13845 (KFK–4809) **The NET articulated boom: Preliminary investigations and justification for a full scale prototype.** Suppan, A. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. Dec 1990. 53p. Order Number DE91759458. Source: OSTI; NTIS (US Sales Only); INIS.

The articulated boom system is the favourite in-vessel handling system for NET which will be used to maintain or replace in-vessel components during short term interventions. The testbed EDITH is the prototype of this system and is the logical step between the proof of principle of the system, which is already performed by the JET articulated boom, and the operational equipment for NET. EDITH is required to demonstrate that maintenance of plasma facing components can be carried out with the anticipated reliability and time. To achieve this aim EDITH is based on the experience of the JET boom and will be constructed in full scale, supplemented by a full scale mock-up. A further goal of EDITH is to allow the testing of boom components and subassemblies. The results of preliminary investigations for the boom are summarized, the need of the testbed EDITH and a full scale mock-up is discussed and both EDITH and the mock-up are described. (orig.).

13846 (LA-UR–91-631) **Tritium and neutron measurements from deuterated Pd-Si.** Claytor, T.N.; Tuggle, D.G.; Menlove, H.O.; Seeger, P.A.; Doty, W.R.; Rohwer, R.K. Los Alamos National Lab., NM (USA). [1990]. 15p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-9010326–1: Nuclear cold fusion conference, Provo, UT (USA), Oct 1990). Order Number DE91008598. Source: OSTI; NTIS; INIS; GPO Dep.

Evidence has been found for tritium and neutron production in palladium and silicon stacks when pulsed with a high electric current. These palladium-silicon stacks consist of alternating layers of pressed palladium and silicon powder. A pulsed high electric current is thought to promote non equilibrium conditions important for tritium and neutron production. More than 2000 hours of neutron counting time has been accumulated in a underground, low background, environment with high efficiency counters (21%). Neutron emission has occurred as infrequent burst or as low level emission lasting for up to 20 hours. In eight of 30 cells, excess tritium greater than 3 sigma has been observed. In each of these measurements, with the powder system, the ratio of tritium detected to total integrated total neutrons inferred has been anomalously high. Recent cells have shown reproducible tritium generation at a level of about 0.5 nCi/hr. Several hydrogen and air control cells have been run with no anomalous excess tritium or neutron emission above background. A significant amount of the total palladium inventory (18%) has been checked for tritium contamination by three independent means. 12 refs., 6 figs., 2 tabs.

13847 (LA-UR–91-728) **Recent laser experiments on the Aurora KrF/ICF laser system.** Turner, T.P.; Jones, J.E.; Czuchlewski, S.J.; Watt, R.G.; Thomas, S.J.; Kang, M.; Tallman, C.R.; Mack, J.M.; Figueira, J.F. Los Alamos National Lab., NM (USA). [1990]. 13p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-901263–8: International conference on lasers '90, San Diego, CA (USA), 10-14 Dec 1990). Order Number DE91008607. Source: OSTI; NTIS; INIS; GPO Dep.

The Aurora KrF/ICF Laser Facility at Los Alamos is operational at the kilojoule-level for both laser and target experiments. We report on recent laser experiments on the system and resulting system improvements. 3 refs., 4 figs.

13848 (ORNL/FTR–3865) **[International Panel on 14 MeV Intense Neutron Source Based on Accelerators for Fusion Materials Study]: Foreign trip report, January 11–22, 1991.** Thoms, K.R.; Wiffen, F.W. Oak Ridge National Lab., TN (USA). 14 Feb 1991. 20p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008550. Source: OSTI; NTIS; INIS; GPO Dep.

Both travelers were members of a nine-person US delegation that participated in an international workshop on accelerator-based 14 MeV neutron sources for fusion materials research hosted by the University of Tokyo. Presentations made at the workshop reviewed the technology developed by the FMIT Project, advances in accelerator technology, and proposed concepts for neutron sources. One traveler then participated in the initial meeting of the IEA Working Group on High Energy, High Flux Neutron Sources in which efforts were begun to evaluate and compare proposed neutron sources; the Fourth FFTF/MOTA Experimenters' Workshop which covered planning and coordination of the US-Japan collaboration using the FFTF reactor to irradiate fusion reactor materials; and held discussions with several JAERI personnel on the US-Japan collaboration on fusion reactor materials.

13849 (PNL-SA–18904) **Workshop on supercomputer utilization in radiation effects modeling.** Ghoniem, N.M. (ed.); Doran, D.G. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-8701172–: Workshop on super computer utilization in radiation effects modeling, La Jolla, CA (USA), 21-23 Jan 1987). Order Number DE91009368. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics related to using supercomputer in radiation effects modeling of thermonuclear reactor materials: supercomputer power and use in Japan; application of the embedded atom method to fracture; application of molecular dynamics computer simulation to studies of the primary state of damage; remarks concerning the simulation of primary damage; defect interactions (Parts 1 and 2); statistical theory of microstructure evolution; kinetic theory of radiation effects; the role of modeling in the US fusion structural materials program; on the relation between analytical approaches and computer simulation in modeling material behavior under irradiation; computer modeling of surface effects; mobility of defects in concentrated alloys; modeling in ceramics; and deformation and fracture continuum approach.

13850 (PSI–81) **Cross-section uncertainty study of the NET shielding blanket.** Jaeger, J.F. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Nov 1990. 13p. Order Number DE91622101. Source: OSTI; NTIS (US Sales Only); INIS.

The Next European Torus (NET) is foreseen as the next step in the European development towards the controlled use of thermonuclear fusion. Detail design of the shielding blanket protecting the peripherals, more especially the super-conducting coils, is well advanced. A cross-section uncertainty, i.e. a study of the expected inaccuracy due to the nuclear cross-section data, has been done for the neutron-gamma reactions in the insulation of the coils for such a design. As an extension of previous work on the NET shielding blanket (e.g. MCNP calculations), it was deemed necessary to estimate the accuracy attainable with transport codes in view of the uncertainties in microscopic cross-sections. The code used, SENSIBL, is based on perturbation theory and uses covariance files, COVFILS-2, for the cross-section data. This necessitates forward and adjoint flux calculations with a transport code (e.g. ONEDANT, TRISM) and folding the information contained in these coupled fluxes with the accuracy estimates of the evaluators of the ENDF/B-V files. Transport, P_5S_{12}, calculations were done with the ONEDANT code, for a shielding blanket design with 714 MW plasma fusion power. Several runs were done to obtain well converged forward and adjoint fluxes (ca. 1%). The forward and adjoint integral responses agree to 2%, which is consistent with the above accuracy. The n-γ response was chosen as it is typical of the general accuracy and is available for all materials considered. The present version of SENSIBL allows direct use of the geometric files of ONEDANT (or TRISM) which simplifies the input. Covariance data is not available at present in COVFILS-2 for all of the materials considered. Only H, C, N, O, Al, Si, Fe, Ni, and Pb could be considered, the big absentee being copper. The resulting uncertainty for the neutron-gamma reactions in the insulation of the coil was found to be 17%. (Abstract Truncated)

13851 (UCRL-CR–105908) **HYLIFE-II power conversion system design and cost study: Final report No. 1.** Hoffman, M.A. (California Univ., Davis, CA (USA). Dept. of Mechanical, Aeronautical and Materials Engineering). Lawrence Livermore National Lab., CA (USA); California Univ., Davis, CA (USA). Dept. of Mechanical, Aeronautical and Materials Engineering. Sep 1990.

102p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. Order Number DE91008566. Source: OSTI; NTIS; INIS; GPO Dep.

The power conversion system for the HYLIFE-2 fusion power plant has been defined to include the IHX's (intermediate heat exchangers) and everything that support the exchange of energy from the reactor. It is referred to simply as the BOP (balance of plant) in the rest of this report. The above is a convenient division between the reactor equipment and the rest of the fusion power plant since the BOP design and cost then depend only on the specification of the thermal power to the IHX's and the temperature of the primary Flibe coolant into and out of the IHX's, and is almost independent of the details of the reactor design. The main efforts during the first year have been on the definition and thermal-hydraulics of the IHX's, the steam generators and the steam power plant, leading to the definition of a reference BOP with the molten salt, Flibe, as the primary coolant. A summary of the key results in each of these areas is given in this report.

13852 (UCRL-JC–103816-Rev.1) **HYLIFE-II inertial confinement fusion reactor design: Revision 1.** Moir, R.W. Lawrence Livermore National Lab., CA (USA). 14 Dec 1990. 9p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-901007–6: 9. topical meeting on technology of fusion energy, Oak Brook, IL (USA), 7-11 Oct 1990). Order Number DE91008736. Source: OSTI; NTIS; INIS; GPO Dep.

The HYLIFE-2 inertial fusion power plant design study uses a liquid fall, in the form of jets to protect the first structural wall from neutron damage, x rays, and blast to provide a 30-y lifetime. HYLIFE-1 used liquid lithium. HYLIFE 2 avoids the fire hazard of lithium by using a molten salt composed of fluorine, lithium, and beryllium (Li_2BeF_4) called Flibe. Access for heavy-ion beams is provided. Calculations for assumed heavy-ion beam performance show a nominal gain of 70 at 5 MJ producing 350 MJ, about 5.2 times less yield than the 1.8 GJ from a driver energy of 4.5 MJ with gain of 400 for HYLIFE-1. The nominal 1 GWe of power can be maintained by increasing the repetition rate by a factor of about 5.2, from 1.5 to 8 Hz. A higher repetition rate requires faster re-establishment of the jets after a shot, which can be accomplished in part by decreasing the jet fall height and increasing the jet flow velocity. Multiple chambers may be required. In addition, although not considered for HYLIFE-1, there is undoubtedly liquid splash that must be forcibly cleared because gravity is too slow, especially at high repetition rates. Splash removal can be accomplished by either pulsed or oscillating jet flows. The cost of electricity is estimated to be 0.09 $/kW·h in constant 1988 dollars, about twice that of future coal and light water reactor nuclear power. The driver beam cost is about one-half the total cost. 15 refs., 9 figs., 3 tabs.

13853 (UCRL-JC–104365) **Modeling the longitudinal wall impedance instability in heavy ion beams using an R-Z PIC code.** Callahan, D.A. (Lawrence Livermore National Lab., CA (USA)); Langdon, A.B.; Friedman, A.; Grote, D.P.; Haber, I. Lawrence Livermore National Lab., CA (USA). 22 Feb 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9011184–1: 1990 international symposium on heavy ion fusion, Monterey, CA (USA), 6-9 Nov 1990). Order Number DE91009477. Source: OSTI; NTIS; INIS; GPO Dep.

The effects of the longitudinal wall impedance instability in a heavy ion beam are of great interest for heavy ion fusion drivers. We are studying this instability using the R-Z thread of the WARP PIC code. We describe the code and our model of the impedance due to the accelerating modules of the induction LINAC as a resistive wall. We present computer simulations which illustrate this instability. 2 refs., 2 figs., 1 tab.

13854 (UCRL-JC–104984-R1) **Characterization of the plasma-switch interaction in the LBL HIF ion source.** Hewett, D.W. (Lawrence Livermore National Lab., CA (USA)); Rutkowski, H.L. Lawrence Livermore National Lab., CA (USA). 10 Dec 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-901219–10: International symposium on heavy ion inertial fusion, Monterey, CA (USA), 3-6 Dec 1990). Order Number DE91009479. Source: OSTI; NTIS; INIS; GPO Dep.

A new way to characterize the performance of the LBL HIF ion source has been found. In the LBL source, ions are drawn from an arc-generated plasma reservoir in which the electrons are confined by a negative-biased "switch" mesh. Stagnation of the plasma is prevented by absorption of the excess ion flow on this mesh. The ion beam is generated by an external negative voltage that provides Child-Langmuir extraction of the ions through the switch mesh. We elucidate the physics requirements of the source and deduce switch mesh parameters needed for successful operation. 2 refs., 2 figs.

13855 (UCRL-JC–105123) **The Basis version of LASNEX.** Dubois, P.F. Lawrence Livermore National Lab., CA (USA). 26 Oct 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9011149–14: 1990 nuclear explosives code developers' conference, Monterey, CA (USA), 6-9 Nov 1990). Order Number DE91009483. Source: OSTI; NTIS; GPO Dep.

We have made major changes to the computer science aspects of our laser fusion simulation program LASNEX. LASNEX is now using the Basis system, a Fortran development system developed over the last six years at Lawrence Livermore National Laboratory. This has given users greatly increased power and flexibility. We have eliminated all non-standard usage and macros, enabling us to begin the port of LASNEX to workstations. At the same time, we have completely redone the system used to maintain the source and create new versions of LASNEX, resulting in major gains in capability and productivity. 5 refs.

13856 (UCRL-JC–105344) **Concept for powering the dipole magnet in a recirculating induction accelerator for heavy ion fusion.** Reginato, L.; Newton, M.; Yu, S. Lawrence Livermore National Lab., CA (USA). Nov 1990. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-901219–11: International symposium on heavy ion inertial fusion, Monterey, CA (USA), 3-6 Dec 1990). Order Number DE91009752. Source: OSTI; NTIS; GPO Dep.

In a Recirculating Heavy Ion Fusion Induction Accelerator the largest energy consumption occurs in the bending magnetic fields. Because these fields are pulsed, they cannot be generated by superconducting magnets. The bending magnets will consist of iron core dipoles with multiturn copper conductors. The energy stored in the magnetic field is many tens of megajoules and over 90% of this energy must be recovered and reused to make this type of accelerator practical. To further make this approach competitive, a cost effective and reliable energy recovery system must be designed. Two similar concepts are proposed which show promise for high efficiency and reasonable cost. A small scale prototype of the pulser and dipole magnet were built and tested. The two systems and very preliminary test results of one will be described. 7 figs.

13857 (UCRL-JC–105733) **Modeling of weakly nonlinear hydrodynamic instabilities in inertial fusion.** Haan, S.W. Lawrence Livermore National Lab., CA (USA). 25 Jan 1991. 19p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910247–1: International conference on research trends in inertial confinement fusion, La Jolla, CA (USA), 4-6 Feb 1991). Order Number DE91008729. Source: OSTI; NTIS; GPO Dep.

Hydrodynamic instabilities are being studied at Livermore with a combination of theoretical, computational, and experimental approaches. Recent emphasis has been on understanding the weakly nonlinear phase. We discuss a second-order theory for this phase, and describe briefly relevant experimental and computational work. We argue that for the fully nonlinear phase on ablatively stabilized foils, a simple saturation model is probably appropriate, even though such a model is not appropriate for fully nonlinear classical Rayleigh-Taylor instability growth. 51 refs., 6 figs.

13858 (UCRL-JC–105830) **Suprathermal particle generation and other plasma effects in laser fusion.** Kruer, W.L. Lawrence Livermore National Lab., CA (USA). 19 Dec 1990. 16p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-9009337–1: International Dawson symposium on the physics of plasma, Los Angeles, CA (USA), 24-25 Sep 1990). Order Number DE91008742. Source: OSTI; NTIS; GPO Dep.

Two basic plasma topics important to the understanding of laser plasma coupling are suprathermal electron generation and nonlinear ion waves. Some old and new results are discussed, including hot electron generation in hohlraum targets. 19 refs., 10 figs.

13859 (UCRL-JC-106275) **Modeling the absorption of intense, short laser pulses in steep density gradients.** Alley, W.E. Lawrence Livermore National Lab., CA (USA). 28 Jan 1991. 7p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910123-14: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91008735. Source: OSTI; NTIS; INIS; GPO Dep.

A subroutine which calculates the absorption of short pulse electromagnetic radiation in a material has been installed into the laser fusion modeling program called LASNEX. Calculational results show the necessity for NLTE physics to account for ionization, the development of non-exponential density profiles for the expanding plasma and movement of the critical point toward the surface which results in Doppler shifts of the reflected light. Comparison of calculations of local scale lengths with experiments shows not only good agreement but the correct scaling with intensity. 8 refs., 5 figs.

13860 (UCRL-JC-106277) **Theory and simulation of Raman scattering in intense, short pulse laser plasma interactions.** Wilks, S.C.; Kruer, W.L.; Langdon, A.B.; Amendt, P.; Eder, D.C.; Keane, C.J. Lawrence Livermore National Lab., CA (USA). 1 Feb 1991. 8p. Sponsored by USDOE,. DOE Contract W-7405-ENG-48. (CONF-910123-15: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91008734. Source: OSTI; NTIS; GPO Dep.

We report on the stimulated Raman scattering (SRS) that occurs when short (~50–100 femtoseconds), intense ($I \sim 2 \times 10^{17}$ W/cm^2) laser pulses are focused into a plasma, or a neutral gas which quickly becomes a plasma due to multiphoton ionization. Review of the usual SRS growth rates will be given, followed by a discussion on how this theory is modified for short pulses. It is found that for some recombination x-ray laser schemes employing short pulses, the Raman instability can potentially heat the electrons to levels that would greatly reduce the efficiency of such a device. However, there are areas in parameter space where the temperature of heated electrons can be kept to acceptable levels. One dimensional, relativistic, particle-in-cell (PIC) simulations are presented. 10 refs., 5 figs.

13861 (UCRL-JC-106737) **DSP: A detailed spectroscopy postprocessor for H-, He-, and Li-like ions.** Keane, C.J. (Lawrence Livermore National Lab., CA (USA)); Lee, R.S.; Grandy, J.P. Lawrence Livermore National Lab., CA (USA). 22 Feb 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9010298-6: International workshop on radiative properties of hot dense matter, Sarasota, FL (USA), 22-26 Oct 1990). Order Number DE91009475. Source: OSTI; NTIS; INIS; GPO Dep.

A detailed plasma spectroscopy postprocessor for H-, He-, and Li-like ions with $6 \leq Z \leq 26$ has been constructed. The structure of the code and the physics contained within it will be described and a sample application given. 15 refs., 5 figs.

13862 (WHC-SA-1068) **Neutronics in d+Li test cell.** Mann, F.M. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 16p. Sponsored by USDOE,. DOE Contract AC06-87RL10930. (CONF-910169-3: International panel on 14 MeV intense neutron source based on accelerators for fusion metals studies, Tokyo (Japan), 14-16 Jan 1991). Order Number DE91007958. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the neutronics of a d + Li test cell based on the experience of the team that designed the Fusion Materials Iteration Test (FMIT) Facility and further developments since the FMIT design. It includes a discussion of the status of the nuclear data and methods used in the test cell design and the results from the FMIT design.

99 GENERAL AND MISCELLANEOUS

13863 (CONF-9104190-1) **Improving risk communication through interactive training in communication skills.** White, D.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); White, R.K. Oak Ridge National Lab., TN (USA). [1991]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From HWHM/HMC-South '91: hazardous waste/hazardous materials conference; Houston, TX (USA); 24-26 Apr 1991. Order Number DE91008366. Source: OSTI; NTIS; GPO Dep.

This paper describes a workshop in communication and public speaking skills recently conducted for a group of public officials whose responsibilities include presenting risk information at public meetings associated with hazardous waste sites. We detail the development and execution of the $2\frac{1}{2}$-day workshop, including the development and integration of a 45-min video of a simulated public meeting used to illustrate examples of good and bad communication behaviors. The workshop uses a mock public meeting video, participatory video exercises, role-playing, an instructor, and a resource text. This interactive approach to teaching communication skills can help sensitize scientists to the public's understanding of risk and improve scientists' confidence and effectiveness in communicating scientific information. 11 refs., 1 fig.

13864 (KFK-4732) **Summarizing annual report 1989, on R and D work performed by the KfK Institute for Microstructural Engineering, IMT.** Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Mikrostrukturtechnik (IMT). Mar 1990. 20p. (In German). Order Number DE91759517. Source: OSTI; NTIS (US Sales Only); INIS.

The main activities of the institute in the year under review continued the work with the separation nozzle method for U-235 enrichment, the testing of separation nozzle elements and the related methods for UF_6 production, and the design and testing of components for separation systems. In another working area, activities centered on microstructural techniques, as e.g. the production of masking blanks or structural masks for the deep-etch synchrotron radiation lithography, on the development of synchrotron radiation sources, or the design of irradiation facilities or wet chemical processes for microstructural techniques. The latter include molding of metals or plastics, surface etching and thin-film deposition. Experiments were carried out for microstructural process development, and product control and analyses for the purpose of quality assurance of microstructures. (HK).

13865 (SAND-90-8254) **Measurement capabilities of the Sandia, Livermore, Standards Laboratories.** Petersen, J.J.; Klevgard, P.A. Sandia National Labs., Livermore, CA (USA). Feb 1991. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DR00789. Order Number DE91008124. Source: OSTI; NTIS; GPO Dep.

This report summarizes the principal measurement services provided by the Sandia, Livermore, Standards Laboratories and lists the nominal levels of measurement accuracy that can be provided to a customer.

9901 Management

Refer also to citation(s) 13202, 13262

13866 (BNL-45792) **An organizational cultural assessment of Lawrence Berkeley Laboratory.** Haber, S.B.; Crouch, D.A. Brookhaven National Lab., Upton, NY (USA). 15 Feb 1991. 91p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91008409. Source: OSTI; NTIS; GPO Dep.

An Organizational Cultural Assessment (OCA) was performed at the Lawrence Berkeley Laboratory (LBL) by administering an Organizational Culture Survey (OCS) that queried employees on the subjects of organizational culture, various aspects of communications employee commitment, work group cohesion, coordination of work, environmental concerns, hazardous nature of work, safety and overall job satisfaction. Many of these subjects are assessed in the OCS through highly developed and validated scales that have been administered in many different types of organizations. Some of the issues, especially the questions on environmental concerns, are newly developed and are still being modified. The purpose of the OCS is to measure in a quantitative and objective way the notion of "culture;" that is, the values, attitudes and beliefs of the individuals working within the organization. In addition,

through the OCS, a broad sample of individuals can be reached that would probably not be interviewed or observed during the course of a typical assessment. The OCS also provides a descriptive profile of the organization at one point in time that can than be compared to a profile taken at a different point in time to assess changes in the culture of the organization. All data from the OCS is presented in group summaries, by division, managerial level, and job classification. Statistically significant differences between groups are identified and discussed. The organizational profile which emerges from the results of the LBL samples is a positive one. The overall cultural style is best described as a constructive one, with high mean scores on the Humanistic, Affiliative, Achievement and Self-actualizing Scales. Four aspects to the communication process were assessed in this OCS; Trust, Accuracy, Interaction and Satisfaction. 9 refs., 57 figs., 6 tabs.

13867 (CONF-9104135–1) **The experience of the Oak Ridge National Laboratory with the analysis of training needs.** Eggers, J.L. (Oak Ridge National Lab., TN (USA)); Tall, D.E. Oak Ridge National Lab., TN (USA). [1991]. 14p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. From 9. symposium on the training of nuclear facility personnel; Denver, CO (USA); 14-18 Apr 1991. Order Number DE91008375. Source: OSTI; NTIS; GPO Dep.

Three conditions combined to necessitate a thorough analysis of training needs for the Oak Ridge National Laboratory: (1) significant recent expansion of potential training requirements for DOE contractors, (2) increased sophistication in the auditing and review criteria, and (3) an historic absence of central attention to the Laboratory's training functions. Laboratory management decided to perform a systematic, ground-up training needs analysis designed to identify the training requirements applicable to the Laboratory, what training is in place identify these requirements, and what training needs to be developed or improved in order to achieve an irreproachable position with regard to personnel training and development. An important goal was the development of an accurate matrix of training requirements versus Laboratory personnel. Needs analysis involved 32 separate organizations with a total of 5600 employees in a wide variety of technical and professional disciplines, more than 200 training programs in place or under development, and approximately 1200 training requirements taken from more than 300 regulations and standards. The project is comprised of three major phases: (1) distribution of training requirements by office or division, (2) development and validation of training standards, and (3) distribution of training standards by individual.

13868 (DOE/MA–0429P) **DOE-Wide Personal Property Management Personnel Directory.** USDOE Office of Procurement, Assistance and Program Management, Washington, DC (USA). Nov 1990. 63p. Sponsored by USDOE,. Order Number DE91008208. Source: OSTI; NTIS; GPO Dep.

This DOE-Wide Personal Property Management Personnel Directory has been developed to encourage and facilitate the sharing of ideas and knowledge of personal property matters between DOE offices. It has been prepared by the Property and Equipment Management Division (PR-162), Office of Procurement Information Systems/Property, Office of Procurement, Assistance and Program Management. We have elected to identify the Organizational Property Management Officer, the individual(s) primarily responsible for motor vehicle and aircraft management, and the Reportable Excess Automated Property System (REAPS) point of contact for each major DOE office. Additionally, this edition of the directory includes FAX numbers where available and identifies property focal points for DOE Management and Operating (M&O) contractors. Points of contact for (M&O) contractors have been included in the directory in order to facilitate networking of property management issues between contractors. DOE offices and contractors are reminded that all property management actions requiring DOE coordination should be processed through the appropriate DOE property management office.

13869 (EUR–12615) **Annual report 89. Central Bureau for nuclear measurements.** Commission of the European Communities, Luxembourg (Luxembourg). 1990. 92p. Source: OSTI; NTIS (US Sales Only).

This report covers CBNM's activities during the second year of the multiannual programme 1988-91. Its contents and form reflect the change in the role and in the working conditions of the Joint Research Center of which CBNM is an institute. The main task of CBNM as covered by the European Communities Framework Programme is defined as the specific programme Nuclear Measurements and Reference Materials. The activities of the CBNM - like for the other institutes of the JRC - are only in part funded as Specific Programme. A small proportion of the specific programme budget is allotted to Exploratory Research, in preparation of possible extensions of existing competences or of potential new activities. Parts of the funding are coming from Support to Other Commission Services and from Work for Third Parties on the basis of contracts. 36 contributions have been presented during a series of international conferences; 24 articles have been submitted for publication in scientific/technical journals.

13870 (EUR–12822) **Annual progress report on nuclear data 1989. Central Bureau for nuclear measurements.** Commission of the European Communities, Luxembourg (Luxembourg). May 1990. 43p. (NEANDC-E–312). Source: OSTI; NTIS (US Sales Only).

In 1989 the efforts for the improvement of the set of standard neutron cross sections and other quantities selected within the INDC/NEANDC Standards File continued. In particular a detailed study of the nuclear mass and charge distribution of the cold and near cold fission of ^{252}Cf yielded understanding of cold mass rearrangements in nuclei. Accuracy of alpha-particle emission probabilities for major transitions in the decay of ^{236}Pu, ^{239}Pu and ^{243}Am was improved to better than 0.5%. In the field of nuclear data for fission technology work was concentrated on European requests in the NEA High Priority Request List. The number of neutrons emitted per neutron absorbed, was obtained for ^{235}U between 2 and 100 meV neutron energy. Using the weighting function determined at CBNM for neutron capture detectors, a new value was obtained for the neutron width of the 1.15 keV resonance in $^{56}Fe\Gamma_n$ = (62.9 ± 2.1) meV. In the field of nuclear data for fusion technology, measurements continued aiming at an improvement of relevant data for neutron transport calculations in the blanket and for prediction of gas production. The radionuclide metrology subproject follows three lines: determination of decay-scheme data, preparation of special standards and the improvement of measurement techniques including international comparisons.

13871 (NIRS–28) **Annual report of National Institute of Radiological Sciences, April 1988 - March 1989.** National Inst. of Radiological Sciences, Chiba (Japan). Jul 1989. 109p. Order Number DE91755688. Source: OSTI; NTIS (US Sales Only); INIS.

The Annual Report of April 1988 - March 1989 provides the information on up-to-date research activities of the National Institute of Radiological Sciences (NIRS) in Japan. Researches undertaken in the NIRS aim at promoting medical application of radiation and at investigating health effects of radiation and radiation protection. The research scope is therefore widely ranging from physics to genetics and from environmental science to clinical medicine. In addition to basic researches carried out by 14 research divisions. This volume is divided into the following scientific categories for ease of reader's understanding: physics, chemistry, biochemistry and biophysics, cell biology, immunology and hematology, pathology and physiology, genetics, clinical research, and environmental science, covering a total of 84 titles. Activities of each research division and organization of the NIRS are given in appendix. (J.P.N.).

13872 (ORNL/TM–10846/R1) **Maintenance Management Department Operational Safety Requirements Program: Revision 1.** Blanton, J.D.; Millet, A.J. Oak Ridge National Lab., TN (USA). Jan 1991. 27p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008075. Source: OSTI; NTIS; GPO Dep.

This document describes the requirements, procedures, and responsibilities of Instrumentation and Controls Division's Maintenance Management Department for instrument maintenance in nonreactor nuclear facilitates at Oak Ridge National Laboratory (ORNL) that have operational safety requirements. Applicable US Department of Energy, Martin Marietta Energy Systems, Inc., and ORNL procedures are referenced. The objective of this document is to present a surveillance plan for nonreactor nuclear facility

safety hardware, thereby fulfilling the requirements of the responsible facility manager. Scheduled maintenance and surveillance plans for components or systems as specified in the ORNL facility operational safety requirements are also addressed. 1 ref., 3 figs.

13873 (SAND–90-2993) **Administrative Information Systems Plan, FY91–FY95.** Detry, R.J.; Pitts, L.H. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 76p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91008072. Source: OSTI; NTIS; GPO Dep.

In FY90 important milestones from past Administrative Information Systems (AIS) plans were realized. The first phase of the Payroll migration was implemented early in the year. This event signified the completion of a major migration milestone and the transition of the Laboratory Information Systems (LIS) machine to a production environment. The Access & Clearance System (A&CS) system and several early deliverables from other migration projects were also implemented during the year. FY91 promises to be another challenging year for those involved with administrative information systems. Aggressive schedules are in effect for the migration projects; the Financial Migration, Human Resources (HR) Migration, and Integrated Procurement System Replacement (IPS/R) efforts will deliver major system components this year. The administrative computing consolidation is underway and will be completed early in FY91. Consolidating computing hardware resources will provide adequate resources and better systems support for the entire AIS community. 8 figs.

9902 Mathematics and Computers

Refer also to citation(s) 12290, 12396, 12520, 12551, 12562, 12564, 12595, 12633, 12659, 12699, 12713, 12714, 12797, 12799, 12846, 12868, 12885, 12888, 12932, 13027, 13028, 13045, 13046, 13139, 13150, 13203, 13215, 13219, 13225, 13226, 13244, 13246, 13273, 13334, 13347, 13352, 13360, 13397, 13424, 13439, 13447, 13459, 13487, 13614, 13615, 13684, 13685, 13693, 13723, 13742, 13743, 13765, 13770, 13814, 13816, 13849, 13855, 13873, 13928, 13930

13874 (BNL–41530-2nd.-Ed.) **VM-CMS tutorial: Second edition.** Brookhaven National Lab., Upton, NY (USA). Apr 1990. 222p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91009444. Source: OSTI; NTIS; GPO Dep.

This report discusses the following topics using VM-CMS; using your virtual machine; the editor (Xedit); more Xedit; properties of your virtual machine; help; adapting CMS to your taste; communicating with other users and transferring files; backup and disk storage on VM/XA; creating and running programs; the batch machine; reading and writing tapes; the FORTRAN full screen interactive debugger IAD; and the vector facility.

13875 (BNL–45634) **Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation.** Feldberg, S.W. Brookhaven National Lab., Upton, NY (USA). [1991]. 2p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910552–6: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91006917. Source: OSTI; NTIS; GPO Dep.

Commencing in the early 60s the application of explicit finite difference (EFD) methods to the analysis of electrochemical problems paralleled the development and availability of fast, main-frame, digital computers. The appeal of the EFD method has been its simplicity of principle and of application. EFD algorithms, however, are notoriously inefficient for solving certain types of stiff problems (e.g., problems involving a wide dynamic range of time constants). In this presentation the author discusses the principles and some applications of a fast quasi-explicit finite difference (FQEFD) method in which the computational speed is enhanced, by many orders of magnitude in some cases, without compromising the user friendliness which has popularized the EFD method. The method is designed to treat electrochemical responses to a discontinuous (e.g, chronoamperometric) perturbation and utilizes the DuFort-Frankel algorithm (1) with exponentially expanding space (2) and exponentially expanding time grids. (A previously published version of the FQEFD method (3,4) was designed to treat electrochemical responses to a continuous (e.g., cyclic voltammetric) perturbation and utilizes the DuFort-Frankel (3) algorithm in conjunction with an exponentially expanding space grid and a uniform time grid. The development of the basic FQEFD equations was presented there). The protocol for introducing the expanding time grid is straightforward and is discussed. 7 refs., 1 fig. 1 tab.

13876 (BONN-IR–90-29) **The graphics system and the data saving for the SAPHIR experiment.** Albold, D. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1990. 51p. (In German). Order Number DE91756461. Source: OSTI; NTIS (US Sales Only); INIS.

Important extensions have been made to the data acquisition system SOS for the SAPHIR experiment at the Bonn ELSA facilities. As support for various online-programs, controlling components of the detector, a graphic system for presenting data was developed. This enables any program in the system to use all graphic devices. Main component is a program serving requests for presentation on a 19 inch color monitor. Window-technique allows a presentation of several graphics on one screen. Equipped with a trackball and using menus, this is an easy to use and powerful tool in controlling the experiment. Other important extensions concern data storage. A huge amount of event data can be stored on 8 mm cassettes by the program Eventsaver. This program can be controlled by a component of the SAPHIR-Online SOL running on a VAX-Computer and using windows and menus. The smaller amount of data, containing parameters and programs, which should be accessible within a small period of time, can be stored on a magnetic disk. A program supporting a file-structure for access to this disk is described. (orig./HSI).

13877 (CEA-LNS-GT–90-05) **Zgoubi users' guide.** Meot, F.; Valero, S. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Oct 1990. 137p. Order Number DE91757071. Source: OSTI; NTIS (US Sales Only).

The computer code Zgoubi calculates trajectories of charged particles in magnetic fields. Specially adapted to the definition and adjustment of magnetic spectrometers, it allows study of complex systems including optical elements such as dipoles, quadrupoles or other lenses. Compared to other codes, it presents several peculiarities: . a numerical method for integrating the Lorentz equation, which optimizes computing time without loss of precision . the possibility of using a mesh, which allows raytracing from simulated or measured (2-D or 3-D) field maps. . Monte Carlo simulation of an unlimited number of trajectories and in-flight decay. The initial version of the Code was developed by D. Garreta and J. C. Faivre at CEN-Saclay. It was perfected for the purpose of studying the four spectrometers (SPES I, II, III, IV) at the National Laboratory, Saturne (CEA-Saclay, France), and SPEG at Ganil (Caen, France). It is now in use in several laboratories. The first manual was in French. Since then many improvements have been implemented. In order to facilitate access to the program this English version of the manual was written at TRIUMF with the assistance of J. Doornbos. P. Stewart prepared the manuscript for publication. This manual is intended only to describe the details of the most recent version of Zgoubi, which is far from being a finished product.

13878 (CONF-910189–1) **GRESS, a preprocessor for sensitivity studies on FORTRAN programs.** Horwedel, J.E. Oak Ridge National Lab., TN (USA). [1991]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Society for Industrial and Applied Mathematics (SIAM) workshop on automatic differentiation of algorithms: theory, implementation, and application; Breckenridge, CO (USA); 6-8 Jan 1991. Order Number DE91009561. Source: OSTI; NTIS; GPO Dep.

Sensitivity and uncertainty analyses are necessary components in the evaluation of computer simulation models. The identification of important model parameters is valuable for ascertaining specific data needs and as a first step in a thorough assessment of parameter uncertainties. This report describes an automated procedure for performing a comprehensive sensitivity analysis using computer calculus. The procedure employs an automated system called

GRESS that utilizes a precompiler to enhance a FORTRAN computer code by adding derivative-taking capabilities. From a single run of an enhanced model, GRESS calculates and reports normalized sensitivities of selected results with respect to all input data. Benchmark results demonstrate that an automated procedure can be used cheaply and efficiently to perform a comprehensive sensitivity analysis of existing computer models. 11 refs., 4 figs.

13879 (CONF-9104189–1) **Two variants of minimum discarded fill ordering.** D'Azevedo, E.F. (Oak Ridge National Lab., TN (USA)); Forsyth, P.A.; Tang, Wei-Pai. Oak Ridge National Lab., TN (USA). [1991]. 11p. Sponsored by Natural Sciences an. DOE Contract AC05-84OR21400. From IMACS symposium on iterative methods in linear algebra; Brussels (Belgium); 2-5 Apr 1991. Order Number DE91007852. Source: OSTI; NTIS; GPO Dep.

It is well known that the ordering of the unknowns can have a significant effect on the convergence of Preconditioned Conjugate Gradient (PCG) methods. There has been considerable experimental work on the effects of ordering for regular finite difference problems. In many cases, good results have been obtained with preconditioners based on diagonal, spiral or natural row orderings. However, for finite element problems having unstructured grids or grids generated by a local refinement approach, it is difficult to define many of the orderings for more regular problems. A recently proposed Minimum Discarded Fill (MDF) ordering technique is effective in finding high quality Incomplete LU (ILU) preconditioners, especially for problems arising from unstructured finite element grids. Testing indicates this algorithm can identify a rather complicated physical structure in an anisotropic problem and orders the unknowns in the "preferred" direction. The MDF technique may be viewed as the numerical analogue of the minimum deficiency algorithm in sparse matrix technology. At any stage of the partial elimination, the MDF technique chooses the next pivot node so as to minimize the amount of discarded fill. In this work, two efficient variants of the MDF technique are explored to produce cost-effective high-order ILU preconditioners. The Threshold MDF orderings combine MDF ideas with drop tolerance techniques to identify the sparsity pattern in the ILU preconditioners. These techniques identify an ordering that encourages fast decay of the entries in the ILU factorization. The Minimum Update Matrix (MUM) ordering technique is a simplification of the MDF ordering and is closely related to the minimum degree algorithm. The MUM ordering is especially for large problems arising from Navier-Stokes problems. Some interesting pictures of the orderings are presented using a visualization tool. 22 refs., 4 figs., 7 tabs.

13880 (CONF-9105112–1) **Functional specifications for mathematical computations.** Boyle, J.M. (Argonne National Lab., IL (USA)); Harmer, T.J. Argonne National Lab., IL (USA). [1991]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From Working conference on constructing programs from specifications; Pacific Grove, CA (USA); 13-16 May 1991. Order Number DE91006002. Source: OSTI; NTIS; GPO Dep.

Are functional programs useful for specifying numerical computations? We believe they certainly are, despite the long-established tradition of using procedural languages for such computations. We have prepared a pure functional specification for an algorithm that solves one-dimensional hyperbolic partial differential equations (PDEs). Using automated program transformations, we have derived a Fortran program from this specification that executes faster on a CRAY X-MP than does the hand-written Fortran implementation of the same algorithm. We discuss the development of the initial specification for the one-dimensional problem and its evolution into a second specification for solving multidimensional hyperbolic PDEs. In this second specification, the dimensionality of the problem is completely parameterized and is given by specifying the set of neighbors of a cell in the grid. Thus, programs can be derived from this specification to solve hyperbolic PDEs of any given dimensionality. Our goal is to elucidate how we approach specifying numerical computations in the functional style and to show how we take advantage of the modularity and abstractness of functional programming to obtain a very high-level representation of the algorithm. We also briefly discuss transformational derivation of efficient programs from such specifications. 13 refs., 1 tab.

13881 (CONF-9105125–1) **Automated computer software development standards enforcement.** Yule, H.P.; Formento, J.W. Argonne National Lab., IL (USA). [1991]. 8p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 4. software engineeering standards application workshop; San Diego, CA (USA); 21-23 May 1991. Order Number DE91007328. Source: OSTI; NTIS; GPO Dep.

The Uniform Development Environment (UDE) is being investigated as a means of enforcing software engineering standards. For the programmer, it provides an environment containing the tools and utilities necessary for orderly and controlled development and maintenance of code according to requirements. In addition, it provides DoD management and developer management the tools needed for all phases of software life cycle management and control, from project planning and management, to code development, configuration management, version control, and change control. This paper reports the status of UDE development and field testing. 5 refs.

13882 (DOE/ER–0486T) **ESnet Program Plan.** USDOE Office of Energy Research,, Washington, DC (USA). Mar 1991. 170p. Sponsored by USDOE,. Order Number DE91008242. Source: OSTI; NTIS; GPO Dep.

The purpose of the Energy Sciences Network (ESnet) Program Plan is to establish, demonstrate, and represent the vision and recommendations of the ESnet Steering Committee regarding ESnet directions and implementations. This document is intended to assist the Office of Energy Research and the Scientific Computing Staff in ESnet program planning and management, including ESnet prioritization and funding. This document contains general information about ESnet in terms of both the current and future needs of Energy Research programs for networking infrastructure. Some historical information about Energy Research networking is provided to afford the reader a perspective from which to evaluate the increasing utility of networking to the Energy Research community. A current ESnet description is provided in detail. ESnet is one of the world's major scientific networks, and the information contained within this document will provide an understanding of ESnet architecture and major components. ESnet provides the Energy Research community with access to many other peer level networks and a multitude of other interconnected network facilities. The reader will be provided with information concerning ESnet's connectivity and interrelationship to other networks and facilities.

13883 (ETDE-IT–91-06) **Note on theory of n-variable generalized Bessel functions.** Dattoli, G.; Chiccoli, C.; Lorenzutta, S.; Maino, G.; Richetta, M.; Torre, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1990. 9p. Order Number DE91752899. Source: OSTI; NTIS (US Sales Only); INIS.

The analytical and numerical aspects of the theory of Generalized Bessel Functions (G.B.F.) have been studied in a number of recent papers. The interest for this type of function has a two-fold motivation: intrinsic mathematical importance; 'practical' importance in the analysis of physical problems, for which the dipole approximation cannot be used. The very early suggestion of G.B.F. was indeed motivated within the context of the analysis of the Compton scattering of electrons by an intense, linearly polarized laser wave. This paper introduces a further generalization of Bessel type functions and discusses the case of a multivariable and one index function. This kind of function can be usefully exploited in problems in which the dipole approximation does not hold and many higher harmonics are simultaneously operating. An analysis is made of the relevant recurrence properties, modified forms and generating functions.

13884 (FAW-TR–90027) **Expert systems for environmental protection. Tutorial.** Guenther, O.; Scheuer, K. Ulm Univ. (Germany, F.R.). Forschungsinstitut fuer Anwendungsorientierte Wissensverarbeitung (FAW). Oct 1990. 11p. (In German). Order Number DE91754842. Source: OSTI; NTIS (US Sales Only).

In this tutorial fundamental knowledge about the mode of operation of expert systems is imparted and possibilities for their application in environmental protection are shown. With the example of three expert systems designed for environmental protection (XUMA, WANDA, EXCEPT) fundamental techniques of expert system programming are explained. (orig.).

13885 (GANIL-P–9020) **Program auto.** Rawool-Sullivan, M.W.; Plagnol, E. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1990. 24p. Order Number DE91752697. Source: OSTI; NTIS (US Sales Only).

The program AUTO was developed to be used in the analysis of dE vs E type spectra. This program is written in FORTRAN and calculates dE vs E lines in MeV. The provision is also made in the program to convert these lines from MeV to ADC channel numbers to facilitate the comparison with the raw data from the experiments. Currently the output of this program can be plotted with the display program, called VISU, but it can also be used independent of the program VISU, with little or no modification in the actual fortran code. The program AUTO has many useful applications. In this article the program AUTO is described along with its applications.

13886 (INIS-XN–305, pp. 7-84) **Introducing NJOY 89.** MacFarlane, R.E. (Los Alamos National Lab. NM (US)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

A new version of the NJOY Nuclear Data Processing Code is described. This version is called NJOY 89, and it supports most of the features of the new ENDF-6 format including the Reich-Moore and Hybrid R-Function resonance representations, heating and damage calculations that make use of File 6 energy-angle distributions, the revised File 7 format for thermal data, and multigroup transfer matrices based on File 6. The multigroup matrices can be computed for incident neutrons or charged-particles, and for outgoing neutrons, photons, charged particles, and recoil nuclei. The MATXS output, module has been upgraded to handle charged particles in order to enable the TRANSX code to prepare multiparticle coupled sets. The plotting module can display ENDF-6 format File 6 data in both 2-d and 3-d perspective forms. In addition, some remaining problems are discussed.

13887 (INIS-XN–305, pp. 85-90) **Maintenance and version identification for NJOY.** Sartori, E. (NEA Data Bank, 91 - Gif-sur-Yvette (FR)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The maintenance methodologies of the CDC UPDATE utility program has been adopted for NJOY. It allows their users to keep track of the history of changes to the code and to document them. This utility exists with almost identical functions both in different makes of control data computers and of CRAY. For other computers, similar utilities exist such as LIBRARIAN or HISTORIAN for IBM, which are to a large extent compatible with the UPDATE methodology. These software products are however available only on a commercial basis. The UPDATE emulators have been developed in recent years in FORTRAN-77 and are therefore portable to a large extent to most computer makes. A more detailed description is annexed in the following.

13888 (INIS-XN–305, pp. 91-107) **ENDF-6 File 30: Data covariances obtained from parameter covariances and sensitivities.** Muir, D.W. (Los Alamos National Lab. NM (US)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

File 30 is provided as a means of describing the covariances of tabulated cross sections, multiplicities, and energy-angle distributions that result from propagating the covariances of a set of underlying parameters (for example, the input parameters of a nuclear-model code), using an evaluator-supplied set of parameter covariances and sensitivities. Whenever nuclear data are evaluated primarily through the application of nuclear models, the covariances of the resulting data can be described very adequately, and compactly, by specifying the covariance matrix for the underlying nuclear parameters, along with a set of sensitivity coefficients giving the rate of change of each nuclear datum of interest with respect to each of the model parameters. Although motivated primarily by these applications of nuclear theory, use of File 30 is not restricted to any one particular evaluation methodology. It can be used to describe data covariances of any origin, so long as they can be formally separated into a set of parameters with specified covariances and a set of data sensitivities.

13889 (INIS-XN–305, pp. 108-118) **Status and future developments of THEMIS nuclear data processing system.** Diop, C.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR). Dept. d'Etudes Mecaniques et Thermiques); Brienne, C. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The THEMIS cross section processing system is composed by a part of NJOY american nuclear data processing system, and by modules and routines which create and use a direct access nuclear data base, called THEMIS library. The PENDF and GENDF sequential data sets and direct access THEMIS library produced by THEMIS are aimed at neutronic and shielding transport codes. The THEMIS cross section processing system is briefly described, and the future developments are indicated.

13890 (INIS-XN–305, pp. 119-125) **Processing of thermal scattering data with NJOY experience and comments.** Mattes, M. (Stuttgart Univ. (DE). Inst. fuer Kernenergetik und Energies systeme). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The THERMR module of NJOY-89 generates pointwise integrated cross sections and double differential neutron scattering cross sections in the thermal energy range where the binding of the scatterer in a material or the motion of atoms in a gas is important. The results are added to an existing PENDF tape using special MT numbers in the range 221 to 250. The cross sections can then be group-averaged with the GROUPR module or plotted and reformated in subsequent modules.

13891 (INIS-XN–305, pp. 126-139) **An intercomparison between kerma factors from Macklib-IV and from NJOY.** Panini, G.C. (ENEA, Bologna (IT)); Rinaldi, G. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

A comparison between the kerma factors produced by NJOY 87.1 and those given in the MACKLIB-IV collection has been carried out. The results of the match are discussed.

13892 (INIS-XN–305, pp. 140-147) **Generation of Matxs-formated nuclear data libraries.** Vontobel, P. (Paul Scherrer Inst. PSI Villigen (CH)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

Using the NJOY nuclear data processing system, three multigroup MATXS-formated nuclear data libraries were generated based on the European data files JEF-1 and EFF-1. After processing with TRAMIX, TRANSX, or TRANSX-CTR these libraries can be red into most transport and diffusion codes. For the neutron analysis of gas-cooled or water moderated thermal reactor systems (including high converter PWR's) a 70-group WIMS-BOXER structured library was generated. A general purpose fine group library in 308 groups is provided for thermal as well as for fast reactor systems. A coupled 175 neutron/42 photon-group library in VITAMIN-J

structure was created for the analysis of shielding problems and fusion blanket design. A problem found when using CRAY's CFT77 compiler to implement NJOY87 is discussed. The problem of irregular selfshielding factors from UNRESR for some isotopes and (σ_0, material temperature)-combinations in the unresolved resonance range is addressed.

13893 (INIS-XN–305, pp. 148-156) **Group cross sections for the assembly code Casmo.** Graegg, C. (STUDSVIK Nuclear Nykoeping (SE)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

NJOY, version 6/83-2+, is at present used together with JEF-1 for generation of group cross sections for the assembly code CASMO. The POWR module in NJOY transformes the output from the module GROUPR to a form suitable for the CASMO data library. Some of the input for POWR is discussed. The output, which can be used directly in the CASMO data library, is described briefly. A table of the isotopes, that have been processed, is given. Finally a discrepancy between data from JEF-1 and ENDF/B-V for Gd-155 is pointed out.

13894 (INIS-XN–305, pp. 157-162) **XLACSR-A module for NJOY(87) for Nordheim resonance treatment.** Leege, P.F.A. de (Technische Univ. Delft (NL)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

XLACSR is a module which can be used in the NJOY code system to generate the data required in the AMPX code package for the Nordheim resonance treatment. The required module UNITABR merges the data from the MILER code and XLACSR module to an AMPX master interface file.

13895 (INIS-XN–305, pp. 163-174) **Group cross-section processing at ECN, Petten (comparison of AMPX, NJOY and GROUPXS results).** Gruppelaar, H. (Netherlands Energy Research Foundation, Petten (NL)); Nierop, D.; Peihua, Y. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

Results of group cross-section processing with the AMPX, NJOY and GROUPXS codes are intercompared. The interfacing codes CRECTJ5 and MILER were used, in addition to the processing codes. In general there is quite good agreement between the AMPX and NJOY results, if the correct input parameters are used. Non-standard input is required for AMPX to obtain the same results as NJOY for thermal scattering. A comparison between GROUPXS and NJOY (version 87.1) was performed to test the processing of recent data files with MF6 of the ENDF-VI Format.

13896 (INIS-XN–305, pp. 175-179) **A nuclear data library for the Kim Monte Carlo code.** Cupini, E. (ENEA, Bologna (IT)); Ferro, G.; Panini, G.C.; Guandalini, R.; Brega, E. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

A new library of nuclear data for the KIM Montecarlo code is presented. The library features the use of the nuclear data file JEF 1.1 as source of data and NJOY version 87.1 as basic processing code. A system of ancillary codes has been written to read PENDF and GENDF and translate selected data into the KIM format.

13897 (INIS-XN–305, pp. 180-205) **Cross section libraries for Ecco and Monk.** Dean, C.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.); Eaton, C.R. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

NJOY87 processes nuclear data used by AEE Technology. The current status of the code is described. Its use for generating MONK6 and ECCO data is explained.

13898 (INIS-XN–305, pp. 206-219) **Validation of new sub-group algorithms for resonance self-shielding in heterogeneous structures.** Rimpault, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (FR)); Ribon, P.; Grimstone, M.; Dean, C.; Thom, B.; Cavarec, C. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

Within the European cooperation on fast reactors a new cell code, ECCO, is being developed. This code uses the sub-group method to handle the resonance self-shielding in complex heterogeneous structures. The ECCO code uses several different energy group schemes. The fine group library allows a reference calculation, while the broad group library permits faster ECCO runs for design calculations. Both fine and broad group libraries contain infinite dilution cross-sections and sub-group parameters, as it is the case for the library FGL5 used by the MURAL code and for the library CARNAVAL4 used by the HETAIRE code. Libraries for ECCO can be created by processing the JEF evaluated nuclear data files. The CALENDF code generates sub-group parameters by an original method while the code system THEMIS, derived from NJOY, is used to calculate infinite dilution cross-sections and the other nuclear data. The consistency between CALENDF and NJOY/THEMIS for the calculation of shielded cross-sections is sufficiently accurate. Results of calculations using these two libraries give good agreement for cells typical of the fast reactor programme. It will be then acceptable to use broad group calculations in cases where fine group calculations are too costly, for example when treating very complicated geometries.

13899 (INIS-XN–305, pp. 220-232) **Statistical probability tables CALENDF program.** Ribon, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR). Dept. d'Etudes Mecaniques et Thermiques). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The purpose of the probability tables is: - to obtain dense data representation - to calculate integrals by quadratures. They are mainly used in the USA for calculations by Monte Carlo and in the USSR and Europe for self-shielding calculations by the sub-group method. The moment probability tables, in addition to providing a more substantial mathematical basis and calculation methods, are adapted for condensation and mixture calculations, which are the crucial operations for reactor physics specialists. However, their extension is limited by the statistical hypothesis they imply. Efforts are being made to remove this obstacle, at the cost, it must be said, of greater complexity.

13900 (INIS-XN–305, pp. 233-238) **NJOY installation on μVAX-II at IJS verification for WIMS library applications.** Trkov, A. (Institute Jozef Stefan Ljubljana (YU)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS*. 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The code NJOY-87 recently became available. A distribution tape was obtained from RSIC and the code was successfully installed on the μVAX-II machine at the Jozef Stefan Institute. Before the test cases could be executed some minor corrections were required. The results differ slightly from the reference solution, particularly the self shielded scattering matrices. For LWR core applications the differences do not seem important but for other applications

they should be examined more closely. In NJOY verification for WIMS library applications the emphasis is on the cross section definitions and the processing errors. The proposed procedure is to create the WIMS library using two independent codes, compare the cross section where possible and analyse in detail the results of the WIMS calculations for some standard benchmark lattice.

13901 (INIS-XN–305, pp. 239-247) **NJOY implementation on IBM/AMDAHL.** Axmann, J.K. (Technische Univ. Braunschweig (DE). Inst. fuer Raumflug- und Reaktortechnik); Holzgrewe, F. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

In early 1988 the Institute of Spaceflight and Reactor Technology at the Technical University of Braunschweig started with the implementation of NJOY 6/83 and a few months later with version 87.0 on IBM/AMDAHL. The use of short word computers beared several machine-dependent problems, which have been solved and which are depicted. Some other errors were found, too and are also listed. Two suggestions concerning COMMON blocks and CHARACTER items conclude the article.

13902 (INIS-XN–305, pp. 248-253) **Njoy modules used at Enea, Frascati to produce an Ace format neutron cross section library from Eff-1 for the Monte Carlo Mcnp.** Petrizzi, L. (ENEA Frascati (IT). Centro Ricerche Energia). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

A note is presented about the experience had in using the NJOY 87.1 module to produce an ACE format library for MCNP from the European Fusion File EFF-1. The IBM 3090 computer, MVS system at ENEA, Bologna was used. The library, called MCNP. EFF1 is at the moment available at Frascati. Few words are said about the met processing problems and the more general topics related to our activity.

13903 (INIS-XN–305, pp. 254-257) **The fusion evaluated data library (FENDL) its processing and related benchmark calculations.** Muir, D.W. (Los Alamos National Lab. NM (US)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

FENDL is a nuclear data library being assembled by the IAEA Nuclear Data Section, in support of a variety of national and international fusion research projects. Notable examples of such projects are the International Experimental Thermonuclear Reactor (ITER), Fusion Engineering Reactor (FER, Japan), and the Next European Torus (NET). The development of the FENDL library is an approved program of the IAEA and is supported by several IAEA Coordinated Research Programs. It appears to me that the planned FENDL data processing and data testing efforts will be a shared effort, with significant contributions coming from the IAEA itself and from the participating research laboratories and data centers.

13904 (INIS-XN–305, pp. 258-264) **A note about Pendf's prepared by Themis-Recons.** Burn, K.W. (ENEA-Bologna, (IT)); Panini, G.C. Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

Short note. T CODES/nuclear data collections; T CODES/implementation; IMPLEMENTATION/ibm computers; IMPLEMENTATION/cray computers; IMPLEMENTATION

13905 (INIS-XN–305, pp. 265-269) **Significant decimal digits for energy representation on short-word computers.** Sartori, E. (NEA Data Bank, 91 - Gif-sur-Yvette (FR)). Nuclear Energy Agency, 75 - Paris (France). 1989. (CONF-8906162–: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay (France), 20-21 Jun 1989). In *Proceedings of the Seminar on NJOY and THEMIS.* 273p. Order Number DE91752641. Source: OSTI; NTIS (US Sales Only).

The general belief that single precision floating point numbers have always at least seven significant decimal digits on short word computers such as IBM is erroneous. Seven significant digits are required however for representing the energy variable in nuclear cross-section data sets containing sharp p-wave resonances at 0 Kelvin. It is suggested that either the energy variable is stored in double precision or that cross-section resonances are reconstructed to room temperature or higher on short word computers.

13906 (JAERI-M–90-199) **INTERF: the reaction rates and spectra editing code for analysis of fusion neutronics experiments.** Kosako, Kazuaki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 120p. (In Japanese). Order Number DE91755641. Source: OSTI; NTIS (US Sales Only); INIS.

The reaction rates and spectra editing code INTERF has been developed for transport calculation codes as a part of the analysis system for fusion neutronics experiments. This code can provide the ratio of calculation to experiment value for reaction rate (C/E), spectra, reaction rate distributions, contour distributions, etc. from results of transport calculation. The transport calculation codes that INTERF can process are the ANISN, DOT3.5, BERMUDA-2DN, MCNP and MORSE-DD codes. In this report, the concept, functions, input data, and input/output files in INTERF are described and the examples of input data for usage of INTERF are shown. (author).

13907 (LA–11966-M) **STRAPP user's manual.** Guerra, F.M. Los Alamos National Lab., NM (USA). Mar 1991. 195p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009846. Source: OSTI; NTIS; GPO Dep.

The Finite Element STRuturcal Analysis Post-Processor (STRAPP) was developed for postprocessing output from finite element programs. Postprocessing capabilities available with this interactive/batch code include contour plotting, transient plots of nodal point parameters, nodal point parameters versus distance plots, and material group summaries. In addition, STRAPP can use the cursor or input data to draw vectors, lines, text, and compute a contour or history plot component at a specified point. The program will output graphics data to a CRT terminal and/or to a CGS-metafile for further post-processing. All input and output data are written onto an ASCII file, and all interactive input is saved in a separate ASCII file. Several examples are used to show the extensive capabilities of the program.

13908 (LA-UR–90-3726) **NADIR [Network Anomaly Detection and Intrusion Reporter]: A prototype network intrusion detection system.** Jackson, K.A.; DuBois, D.H.; Stallings, C.A. Los Alamos National Lab., NM (USA). [1990]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910596–1: IEEE symposium on research in security and privacy, Oakland, CA (USA), May 1991). Order Number DE91004823. Source: OSTI; NTIS; GPO Dep.

The Network Anomaly Detection and Intrusion Reporter (NADIR) is an expert system which is intended to provide real-time security auditing for intrusion and misuse detection at Los Alamos National Laboratory's Integrated Computing Network (ICN). It is based on three basic assumptions: that statistical analysis of computer system and user activities may be used to characterize normal system and user behavior, and that given the resulting statistical profiles, behavior which deviates beyond certain bounds can be detected, that expert system techniques can be applied to security auditing and intrusion detection, and that successful intrusion detection may take place while monitoring a limited set of network activities such as user authentication and access control, file movement and storage, and job scheduling. NADIR has been developed to employ these basic concepts while monitoring the audited activities of more than 8000 ICN users.

13909 (LA-UR-91-334) **A phased approach to network intrusion detection.** Jackson, K.A.; DuBois, D.H.; Stallings, C.A. Los Alamos National Lab., NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9105126–1: DOE computer security group conference, Concord, CA (USA), 7-9 May 1991). Order Number DE91007481. Source: OSTI; NTIS; GPO Dep.

This paper describes the design and development of a prototype intrusion detection system for the Los Alamos National Laboratory's Integrated Computing Network (ICN). The development of this system is based on three basic assumptions: (1) that statistical analysis of computer system and user activates may be used to characterize normal system and user behavior, and that given the resulting statistical profiles, behavior which deviates beyond certain bounds can be detected, (2) that expert system techniques can be applied to security auditing and intrusion detection, and (3) that successful intrusion detection may take place while monitoring a limited set of network activities. The Network Anomaly Detection and Intrusion Reporter (NADIR) design intent was to duplicate and improve the audit record review activities which had previously been undertaken by security personnel, to replace the manual review of audit logs with a near realtime expert system.

13910 (LA-UR-91-678) **Computer animation of NASTRAN Displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results.** Fales, J.L. Los Alamos National Lab., NM (USA). [1991]. 12p. Sponsored by U.S. DOE Contract W-7405-ENG-36. (CONF-9104194–1: 1991 NASTRAN users colloquium, Williamsburg, VA (USA), 22-26 Apr 1991). Order Number DE91008605. Source: OSTI; NTIS; GPO Dep.

The capabilities of the postprocessing program CANDI (Color Animation of Nastran DIsplacements) have been expanded to accept results from axisymmetric analyses. An auxiliary program, ANIMATE, has been developed to allow color display of CANDI output on the IRIS 4D-series workstations. The user can interactively manipulate the graphics display by three-dimensional rotations, translations, and scaling through the use of the keyboard and/or dials box. The user can also specify what portion of the model is displayed. These developments are limited to the display of complex displacements calculated with the NASHUA/NASTRAN procedure for structural acoustics analyses. 4 refs., 6 figs., 1 tab.

13911 (LA-UR-91-729) **Application of neural networks and information theory to the identification of E. coli transcriptional promoters.** Abremski, K. (Du Pont Merck Pharmaceutical Co., Wilmington, DE (USA). Experimental Station); Sirotkin, K.; Lapedes, A. Los Alamos National Lab., NM (USA). [1991]. 15p. Sponsored by USDOE,. DOE Contract W-7405-ENG-36. (CONF-910295–1: 8. international conference on mathematical and computer modelling, College Park, MD (USA), 14 Feb 1991). Order Number DE91008608. Source: OSTI; NTIS; GPO Dep.

The Humane Genome Project has as its eventual goal the determination of the entire DNA sequence of man, which comprises approximately 3 billion base pairs. An important aspect of this project will be the analysis of the sequence to locate regions of biological importance. New computer methods will be needed to automate and facilitate this task. In this paper, we have investigated use of neural networks for the recognition of functional patterns in biological sequences. The prediction of Escherichia coli transcriptional promoters was chosen as a model system for these studies. Two approaches were employed. In the fist method, a mutual information analysis of promoter and nonpromoter sequences was carried out to demonstrate the informative base positions that help to distinguish promoter sequences from non-promoter sequences. These base positions were than used to train a Perceptron to predict new promoter sequences. In the second method, the experimental knowledge of promoters was used to indicate the important base positions in the sequence. These base positions were used to train a back propagation network with hidden units which represented regions of sequence conservation found in promoters. With both types of networks, prediction of new promoter sequences was greater than 96.9%. 12 refs., 1 fig., 4 tabs.

13912 (LBL–30110) **Promoting a healthy skepticism with regard to information processing: The development of a computer security program for a collaborative research environment.** Stevens, D.F. Lawrence Berkeley Lab., CA (USA). Jan 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9105129–1: 7. international conference and exhibition on information security: creating confidence in information processing, Brighton (UK), 15-17 May 1991). Order Number DE91007697. Source: OSTI; NTIS; GPO Dep.

Computer security professionals and members of collaborative research environments have conflicting objectives with respect to computer and network access, and different understandings of what constitutes a "reasonable" organization. These differences create tension between the two communities and make the achievement of an acceptable level of security a matter of some difficulty in such environments. We consider some of the differences and present the elements of a program aimed at promoting sensible computer and network security in the research milieu.

13913 (LPCCT–9001) **Setting graphic software for data examination of multidetector used in heavy ions physic.** Le Flecher, C. Caen Univ., 14 (France). Lab. de Physique Corpusculaire; Caen Univ., 14 (France). 1990. 66p. (In French). Order Number DE91757086. Source: OSTI; NTIS (US Sales Only).

In this work, the first chapter presents both the multidetectors of the vacuum chamber NAUTILUS, from a geometrical and parametrical point of view and the manual analysis phase. The second part deals with the main notions of the language Graphical Kernel System. Finally, the third chapter is a presentation of the different graphical programs written in order to accelerate and rationalize the analysis phase.

13914 (LRP–425/90) **Tunable integration scheme for the finite element method.** Bondeson, A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Fu, G.Y. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Dec 1990. 22p. Order Number DE91623476. Source: OSTI; NTIS (US Sales Only); INIS.

A discretization method is proposed where a tunable integration scheme is applied to the finite element method (FEM). The method is characterized by one continuous parameter, p. Three different eigenvalue problems are used as test cases: a simple example with constant coefficients and two model problems from ideal and resistive magnetohydrodynamics. The numerical examples and a theoretical error analysis show that, for judicious choices of p, the tunable integration method clearly improves the accuracy of the strict FEM. The sensitivity to the choice of integration parameter is discussed. (author) 4 figs., 13 refs.

13915 (ORNL/CSD/TM–277) **SSCR User's Guide, Version 1.0.** Oak Ridge National Lab., TN (USA). Computing and Telecommunications Div. Mar 1991. 178p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91008915. Source: OSTI; NTIS; GPO Dep.

This manual describes the online SSCR System and is written for systems programmers in the Computing and Telecommunications Division. An SSCR (System Software Change Record) is a form that must be completed for all central computing system software changes. The manual is organized as follows: Chapter 1 introduces the SSCR System and describes the terms used; Chapter 2 tells how to access and navigate the System; Chapters 3 through 16 describe the functions available through the SSCR System. Each function is organized in a step-by-step fashion, with text on the left-hand page and corresponding examples on the right-hand page; and the appendices include information to help you customize the SSCR System by setting a default editor and creating mail distribution lists. The appendices also include keyboard layouts for the supported editors, a quick reference card for using the SSCR System, and information for converting from SAM to the SSCR System.

13916 (ORNL/TM–11744) **Hypercube clock synchronization.** Dunigan, T.H. Oak Ridge National Lab., TN (USA). Mar 1991. 15p. Sponsored by USDOE,. DOE Contract AC05-84OR21400. Order Number DE91009222. Source: OSTI; NTIS; GPO Dep.

Algorithms for synchronizing the times and frequencies of the clocks of Intel and Ncube hypercube multiprocessors are presented.

Bounds for the error in estimating clock offsets and frequencies are formulated in terms of the clock read error and message transmission time. Clock and communication performance of the Ncube and Intel hypercubes are analyzed, and performance of the synchronization algorithms is presented. 14 refs., 4 figs., 3 tabs.

13917 (ORNL/TM–11768) **The IBM RISC System/6000 and linear algebra operations.** Dongarra, J.J. (Tennessee Univ., Knoxville, TN (USA). Dept. of Computer Science); Mays, P.; Radicati di Brozolo, G. Oak Ridge National Lab., TN (USA). Jan 1991. 26p. Sponsored by USDOE, Was. DOE Contract AC05-84OR21400. Order Number DE91009221. Source: OSTI; NTIS; GPO Dep.

This paper discusses the IBM RISC System/6000 workstation and a set of experiments with blocked algorithms commonly used in solving problems in numerical linear algebra. We describe the performance of these algorithms and discuss the techniques used in achieving high performance on such an architecture. 10 refs., 11 figs., 6 tabs.

13918 (PNL-SA–19026) **Multiphase, multi-electrode Joule heat computations for glass melter and in situ vitrification simulations.** Lowery, P.S.; Lessor, D.L. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 27p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. (CONF-910287–2: National research and development conference on the control of hazardous materials, Anaheim, CA (USA), 20-22 Feb 1991). Order Number DE91008261. Source: OSTI; NTIS; INIS: GPO Dep.

Waste glass melter and in situ vitrification (ISV) processes represent the combination of electrical thermal, and fluid flow phenomena to produce a stable waste-from product. Computational modeling of the thermal and fluid flow aspects of these processes provides a useful tool for assessing the potential performance of proposed system designs. These computations can be performed at a fraction of the cost of experiment. Consequently, computational modeling of vitrification systems can also provide and economical means for assessing the suitability of a proposed process application. The computational model described in this paper employs finite difference representations of the basic continuum conservation laws governing the thermal, fluid flow, and electrical aspects of the vitrification process – i.e., conservation of mass, momentum, energy, and electrical charge. The resulting code is a member of the TEMPEST family of codes developed at the Pacific Northwest Laboratory (operated by Battelle for the US Department of Energy). This paper provides an overview of the numerical approach employed in TEMPEST. In addition, results from several TEMPEST simulations of sample waste glass melter and ISV processes are provided to illustrate the insights to be gained from computational modeling of these processes. 3 refs., 13 figs.

13919 (SAND–90-1706C) **Structural analysis on massively parallel computers.** Vaughan, C.T. Sandia National Labs., Albuquerque, NM (USA). [1991]. 15p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910207–3: Meeting on parallel methods on large-scale structural analysis and physics applications, Hampton, VA (USA), 5-6 Feb 1991). Order Number DE91009038. Source: OSTI; NTIS; GPO Dep.

An implementation is presented for JAC3D on two massively parallel hypercube computers. JAC3D, a three dimensional finite element code developed at Sandia, uses several hundred hours of Cray time each year in solving structural analysis problems. Two major areas of investigation are discussed: (1) the development of general methods, data structures, and routines to communicate information between processors, and (2) the implementation and evaluation of four algorithms to map problems onto the node processors of the hypercube in a load-balanced fashion. The performance of JAC3D on a 1024-processor NCUBE 2 and NCUBE/ten hypercubes is compared with that on a Cray X-MP: the NCUBE 2 version presently takes 20% of the compute time of a Cray processor. 10 refs., 2 figs., 5 tabs.

13920 (SAND–90-2336C) **Uncertainty estimates for derivatives and intercepts.** Clark, E.L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910531–1: 37. annual technical meeting and equipment exposition of the Institute of Environmental Sciences (IES), San Diego, CA (USA), 6-10 May 1991). Order Number DE91004503. Source: OSTI; NTIS; GPO Dep.

Straight line least squares fits of experimental data are widely used in the analysis of test results to provide derivatives and intercepts. A method for evaluating the uncertainty in these parameters is described. The method utilizes conventional least squares results and is applicable to experiments where the independent variable is controlled, but not necessarily free of error. A Monte Carlo verification of the method is given 7 refs., 2 tabs.

13921 (SAND–90-2550C) **Signal parameter algorithms for trend analysis of digital data acquisition systems.** Lee, J.W. Sandia National Labs., Albuquerque, NM (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105135–1: IEEE instrumentation/measurement technology conference, Atlanta, GA (USA), 14-16 May 1991). Order Number DE91008171. Source: OSTI; NTIS; GPO Dep.

This paper describes a set of Fortran subroutines that calculate a comprehensive set of characterization parameters of any uniformly sampled discrete-time wave-form. The parameters and algorithms are based on IEEE Standard 194-1977. Pulse Terms and Definitions, and IEEE Standard 181-1977, Pulse Measurement and Analysis by Objective Techniques. These subroutines are being used extensively for trend analysis of the performance of digital data acquisition systems in the Nevada Test Site field instrumentation system. The algorithms are designed to be independent of pulse shape and polarity. 6 refs., 8 figs.

13922 (SAND–91-0401C) **Chaotic and random processes.** Paez, T.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910531–3: 37. annual technical meeting and equipment exposition of the Institute of Environmental Sciences (IES), San Diego, CA (USA), 6-10 May 1991). Order Number DE91008574. Source: OSTI; NTIS; GPO Dep.

System dynamicists frequently encounter signals they interpret as realizations of normal random processes. To simulate these analytically and in the laboratory they use methods that yield approximately normal random signals. The traditional digital methods for generating such signals have been developed during the past 25 years. During the same period of time much development has been done in the theory of chaotic processes. The conditions under which chaos occurs have been studied, and several measures of the nature of chaotic processes have been developed. Some of the measures used to characterize the nature of dynamic system motions are common to the study of both random vibrations and chaotic processes. This paper considers chaotic processes and random vibrations. It shows contrasts between the two and situations where they are indistinguishable. The applicability of the Central Limit Theorem to chaotic processes is demonstrated. 12 refs., 8 figs.

13923 (SAND–92-0402C) **A modified SLIC material interface reconstruction algorithm for Eulerian codes.** Bell, R.L. (Amparo Corp., Albuquerque, NM (USA)); Rottler, J.S. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-9011149–13: 1990 nuclear explosives code developers' conference, Monterey, CA (USA), 6-9 Nov 1990). Order Number DE91009175. Source: OSTI; NTIS; GPO Dep.

One of the chief disadvantages associated with the use of an Eulerian mesh is the difficulty in accurately constructing material interfaces as materials move through the mesh. The Simple Line Interface Calculation (SLIC) algorithm developed by Noh and Woodward at Lawrence Livermore National Laboratory has been used successfully, but it has certain problems. The SLIC algorithm is accurate only when an interface is parallel or perpendicular to the direction of the flow, and it will modify interfaces that are not oriented perpendicular or parallel to the flow. The Modified SLIC (MSLIC) algorithm presented in this paper greatly improves the accuracy of the SLIC algorithm while retaining much of the simplicity of the original algorithm. MSLIC is available for two and three dimensional calculations. 6 refs., 10 figs.

13924 (SLAC-TN–91-1) **Introduction to AmigaTEX.** Weinstein, A.J.; Weinstein, M. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 15 Feb 1991. 23p. Sponsored by USDOE,. DOE Contract AC03-76SF00515. Order Number DE91008518. Source: OSTI; NTIS; GPO Dep.

Amiga TEX is the Amiga's version of TEX, Donald Knuth's computer typesetting system, designed to take a text file and produce a printed manuscript. People who have used TEX on the IBM mainframe know that producing a final copy using the TEX system involves three independent steps. First, one uses an editor, e.g. XEDIT, to prepare the text file; next, one TEX's the file in order to produce a device independent (DVI) file; finally, one uses the program IMATEX to send the DVI file to a laser printer. Using TEX on a personal computer involves the same sequence of steps. In the cast of the Commodore Amiga, the editor is probably TxEd Plus and the TEX program will be Amiga TEX. One major difference between the IBM mainframe and the Amiga environment is that one does not have to print a TEX file in order to read it. One can instead use another program, Preview, to display the formatted file on the screen. In general, the output produced by TEX is far superior to that produced by a "What You See Is What You Get" word processor; that is especially true for technical documents. Also, because the files which TEX uses are plain text files, transporting such files from site to site or machine to machine is straightforward. For these reasons SLAC uses TEX to prepare most technical documents. The only disadvantage to using TEX is that learning to use all of the power at your command takes some time. Fortunately, most people don't want to use all this power, they just want to get their work done in as straightforward a manner as possible. Learning to do this is not so difficult, especially if one begins on a machine like the Amiga which can set up to provide a user-friendly interface to TEX. The aim of this document is to provide an introduction to the Amiga's TEX environment for the novice user.

13925 (UCRL-JC–105017) **Creative system test design using object-oriented analysis.** Storch, N.A. Lawrence Livermore National Lab., CA (USA). Sep 1990. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9105123–1: 13. international conference on software engineering, Austin, TX (USA), 13-16 May 1991). Order Number DE91007124. Source: OSTI; NTIS; GPO Dep.

This paper describes actual experiences in designing system level test cases for a large on-line transaction system which keeps track of work orders and payroll for a complex of machine shops. These system tests were designed after the software had been written and the system was about to undergo user acceptance testing. It was an effort independent of the development, intended to improve the overall quality of the delivered system. Although accepted software engineering methods had been used extensively during the development, at the time of these system tests, up-to-date documentation was limited to the user manual. Knowledgeable persons were mostly unavailable, busy with completion of the system. Nevertheless, in this real world situation, the system test cases were needed in a timely fashion. After more conventional tests were designed and run yielding no bugs, a new approach was taken. This involved identifying a major section of the software as an object and then developing a state model for it based on the implementation and availability of certain process information in the database such as: track flags, status, and time stamps. A flow graph was derived from the state transition diagram. Application of basis path testing to a simplified version of the flow graph lead to a meaningful set of test cases which when run found errors. Not only was this testing a success, but the creation of the state model provided valuable documentation for further understanding and maintenance of the software. 7 refs., 3 figs.

13926 (UCRL-JC–105791) **Verification of secure distributed systems in higher order logic: A modular approach using generic components.** Alves-Foss, J.; Levitt, K. Lawrence Livermore National Lab., CA (USA). 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910596–2: IEEE symposium on research in security and privacy, Oakland, CA (USA), May 1991). Order Number DE91007635. Source: OSTI; NTIS; GPO Dep.

In this paper we present a generalization of McCullough's restrictiveness model as the basis for proving security properties about distributed system designs. We mechanize this generalization and an event-based model of computer systems in the HOL (Higher Order Logic) system to prove the composability of the model and several other properties about the model. We then develop a set of generalized classes of system components and show for which families of user views they satisfied the model. Using these classes we develop a collection of general system components that are instantiations of one of these classes and show that the instantiations also satisfied the security property. We then conclude with a sample distributed secure system, based on the Rushby and Randell distributed system design and designed using our collection of components, and show how our mechanized verification system can be used to verify such designs. 16 refs., 20 figs.

13927 (UCRL-JC–105962) **Policy route certification: Requirements and techniques.** Nessett, D. (Lawrence Livermore National Lab., CA (USA)); Solo, D. Lawrence Livermore National Lab., CA (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9105124–1: IFIP SEC '90, Brighton (UK), 15-17 May 1991). Order Number DE91007259. Source: OSTI; NTIS; GPO Dep.

The interconnection of separately administrated, autonomous communications networks into a large internetwork of global extent raises significant technical, managerial and security issues. Individual networks, or collections of networks, may exhibit different characteristics with respect to usage rules, cost, performance, and security services. In a large internetwork of autonomously administered constituent networks, clients of routing services may wish to obtain security and other service guarantees for their internetwork traffic. This paper analyzes requirements for these guarantees and suggests techniques to meet these requirements based on policy routing mechanisms.

9903 Information Handling

Refer also to citation(s) 12396, 12888, 13417, 13799, 13838, 13911

13928 (DPSPM-GEN–36) **The JOSHUA users' manual.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. Sep 1987. 156p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE91008549. Source: OSTI; National Energy Software Center (software packages only), Argonne National Laboratory, 9800 South Cass Avenue, Argonne, IL 60439. Order documentation without complete package from NTIS; GPO Dep.

This report discusses the Joshua system of computer architecture consisting of a data base, text editor, and terminal system. Program development, program execution, utilities, libraries; and quality assurance procedures are all discussed in this manual. (LSP)

13929 (GSF–5/90) **Ecosystematic monitoring programmes for environmental chemicals.** Forster, E.M.; Peichl, L.; Matthies, M. Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.). Jan 1990. 180p. (In German). Order Number DE91756678. Source: OSTI; NTIS (US Sales Only).

The report gives a summary of the current activities on the area of ecosystem-monitoring in the Federal Republic of Germany. 81 monitoring programmes on the fields of environmental-, food- and feedstuff monitoring, radioecological monitoring and human monitoring are dealt with. A catalogue of questions was developed in order to identify the concept of the monitoring programmes, the monitoring approaches and -objectives. Sample description, site conditions, measuring areas, sampling, measuring technology, analysis, quality assurance and interfaces with other monitoring programmes. Results are stored in a special data base called 'ECOMON' and are available for interested parties. (KST).

13930 (GSF–21/90) **Information system for environmental chemicals. Final report.** Voigt, K.; Benz, J.; Eder, A. Gesellschaft

fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.). Jun 1990. 95p. (In German). Order Number DE91759351. Source: OSTI; NTIS (US Sales Only).

In the project 'information systems for environmental chemicals', an ADP-based system was created to allow access to information about chemicals and to optimize this. To this end, data banks were set up to record the contents of data sources (data banks of data sources). Since the data sources are divided from a practical point of view into printed documents e.g. handbooks, reports, monographs, trade directories etc., online data banks and special editions, three data banks have been set up: PUCLIT for the acquisition of printed documents, PUCDB for online data banks, PUCSO for special editions. The information system set up was checked for performance against the parameter of presence in the environment e.g. in water, earth, air, food and drinking-water of 68 environmentally relevant materials. A hierarchically organized thesaurus was developed for this. The number of items of information found (hits) was between zero and several hundred per material. The results were stored in the factual data bank PUC68. (orig./KST).

13931 (ORNL–6609) **Communication of emergency public warnings: A social science perspective and state-of-the-art assessment.** Mileti, D.S. (Colorado State Univ., Fort Collins, CO (USA)); Sorensen, J.H. Oak Ridge National Lab., TN (USA). Aug 1990. 161p. Sponsored by U.S. DOE Contract AC05-84OR21400. Order Number DE91004981. Source: OSTI; NTIS; GPO Dep.

More than 200 studies of warning systems and warning response were reviewed for this social science perspective and state-of-the-art assessment of communication of emergency public warnings. The major findings are as follows. First, variations in the nature and content of warnings have a large impact on whether or not the public heeds the warning. Relevant factors include the warning source; warning channel; the consistency, credibility, accuracy, and understandability of the message; and the warning frequency. Second, characteristics of the population receiving the warning affect warning response. These include social characteristics such as gender, ethnicity and age, social setting characteristics such as stage of life or family context, psychological characteristics such as fatalism or risk perception, and knowledge characteristics such as experience or training. Third, many current myths about public response to emergency warning are at odds with knowledge derived from field investigations. Some of these myths include the "keep it simple" notion, the "cry wolf" syndrome, public panic and hysteria, and those concerning public willingness to respond to warnings. Finally, different methods of warning the public are not equally effective at providing an alert and notification in different physical and social settings. Most systems can provide a warning given three or more hours of available warning time. Special systems such as tone-alert radios are needed to provide rapid warning. 235 refs., 8 figs., 2 tabs.

13932 (PNL–7375) **Clearance of selected data fields within the Hanford ground-water data base.** Rieger, J.T. Pacific Northwest Lab., Richland, WA (USA). May 1990. 27p. Sponsored by USDOE,. DOE Contract AC06-76RL01830. Order Number DE91008190. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Ground-Water Database (HGWDB) is a computerized database used to store information and data concerning ground-water monitoring at the Hanford Site. It was developed, and is managed and maintained, by Pacific Northwest Laboratory (PNL) for the Department of Energy-Richland and Laboratory (DOE-RL). Sample analytical, hydraulic head, and temperature data are stored in the HGWDB, along with supporting information such as geologic, well location and elevation, well-structure, pump, and sample schedule data. The largest group of data is the analytical data for environmental samples. Some quality control data and CERCLA soils data are also included. Data verification is performed after data are entered into the data base. Since WDOE is being granted access to entire data sets, they will have access to both verified and unverified data. Attachment A contains information on access and attachment B contains sample records.

13933 (SAND–91-0517C) **Relational databases with NIAM models bid "so long" to top-down designs.** Eaton, D.S. Sandia National Labs., Albuquerque, NM (USA). [1991]. 65p. Sponsored by USDOE,. DOE Contract AC04-76DP00789. (CONF-910276–4: Southwest Regional INGRES Users Association meeting, Albuquerque, NM (USA), 28 Feb - 1 mar 1991). Order Number DE91009191. Source: OSTI; NTIS; GPO Dep.

Relational databases have many advantages over former hierarchical and network systems – the most important advantage is their ease of modification. This leads designers to a new approach, which we at our company are finding very useful in building an information system of corporate-wide shared data. This approach is a phased bottom-up design and application development which is supported by an information modeling method called NIAM (Nijssen's Information Analysis Method). NIAM is not well known in the USA, but is widely used in Europe. An introduction to the NIAM approach and its advantages will be followed by examples of models and their corresponding relational database designs that have been developed in step-wise fashion at our company. Since NIAM algorithms yield tables in fifth normal form, our relational systems are implemented for optimum update capabilities and enforceable referential integrity. 4 refs., 6 figs.

9904 Law

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	16:12561	DOE/RL-91-01
AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls, ID (USA)**	
	16:12845	DOE/ID-10289(90)
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering	
	16:12521	NUREG/CR-5672-Vol.1
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research	
	16:12866	NUREG/CR-5667
AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA)**	
	16:12455	WINCO-1081
	16:12549	WINCO-1083
	16:13355	WINCO-1082
AC08-85NV10384	**Nevada Univ., Reno, NV (USA). Water Resources Center**	
	16:13502	DOE/NV/10384-38
AC08-88NV10617	**EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Remote Sensing Lab.**	
	16:13458	EGG-10617-1062
AC08-90NV10845	**Nevada Univ., Reno, NV (USA). Water Resources Center**	
	16:13589	DOE/NV/10845-4
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	16:12481	DP-1778
	16:13117	DP-MS-87-2-Rev.1
	16:13928	DPSPM-GEN-36
	Savannah River Lab., Aiken, SC (USA)	
	16:12831	DPST-86-244
	16:13504	DPST-88-375
	16:13065	MEA-2221
AC09-89SR18035	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	16:12481	DP-1778
	16:13117	DP-MS-87-2-Rev.1
	16:13928	DPSPM-GEN-36
	Savannah River Lab., Aiken, SC (USA)	
	16:12831	DPST-86-244
	16:13504	DPST-88-375
	16:13065	MEA-2221
	Westinghouse Savannah River Co., Aiken, SC (USA)	
	16:12550	WSRC-MS-90-274
	16:12551	WSRC-TR-90-391
	16:12552	WSRC-TR-90-526-Rev.1
	16:12553	WSRC-TR-90-527-Rev.1
	16:12554	WSRC-TR-90-528-Rev.1
	16:12555	WSRC-TR-90-539-Rev.1
	16:12569	WSRC-RP-89-1315
	16:12825	WSRC-MS-90-341
	16:12826	WSRC-TR-90-14
	16:12869	WSRC-MS-90-12
	16:12870	WSRC-MS-90-15
	16:12871	WSRC-RP-89-1390
	16:12898	WSRC-MS-90-280-Rev.1
	16:13450	WSRC-RP-90-1209
	16:13520	WSRC-RP-90-778

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AC21-87MC23283	**Institute of Gas Technology, Chicago, IL (USA)**	
	16:12292	CONF-891130-6
AC21-87MC24266	**Institute of Gas Technology, Chicago, IL (USA)**	
	16:12295	CONF-900801-42
	16:12301	CONF-900859-1
	16:12302	CONF-900859-2
	16:12303	DOE/MC/24266-2959
AC22-86PC90751	**PSI Technology Co., Andover, MA (USA)**	
	16:12393	DOE/PC/90751-T6
	16:12394	DOE/PC/90751-T7
AC22-87PC79680	**Montana State Univ., Bozeman, MT (USA). Dept. of Electrical Engineering**	
	16:12911	DOE/PC/79680-T6
AC22-87PC90005	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
	16:12312	DOE/PC/90005-T33
	16:12313	DOE/PC/90005-T35
AC22-87PC90274	**Avco-Everett Research Lab., Inc., Everett, MA (USA)**	
	16:13016	CONF-9006105-14
AC22-89PC89908	**Aspen Technology, Inc., Cambridge, MA (USA)**	
	16:12290	DOE/PC/89908-T5
AC22-90PC90044	**Lehigh Univ., Bethlehem, PA (USA)**	
	16:12314	DOE/PC/90044-1
AC22-90PC90361	**North Dakota Univ., Grand Forks, ND (USA). Energy and Environmental Research Center**	
	16:12646	DOE/PC/90361-T1
AI01-85CE50111	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	16:13017	DOE/NASA-0336-2
AI01-85CE89008	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	16:13020	JPL-D-7824
AI01-86CE90237	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	16:13199	JPL-D-8051
AM03-76SF00893	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
	16:12497	GEFR-00482
AS03-76EV70210	**California Univ., Davis, CA (USA). Dept. of Genetics**	
	16:13539	DOE/EV/70210-T2
AS05-76ER03956	**International Centre for Theoretical Physics, Trieste (Italy)**	
	16:13643	CONF-9006275-3
AS05-76ER04936	**Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy**	
	16:13728	CONF-9005238-4
AS05-88ER40457	**Prairie View A and M Univ., TX (USA)**	
	16:13629	DOE/ER/40457-T1
AS06-88ER40423	**Washington Univ., Seattle, WA (USA). Dept. of Physics**	
	16:13663	DOE/ER/40423-12-P90
	16:13664	DOE/ER/40423-15
	16:13665	DOE/ER/40423-16-P90
	16:13666	DOE/ER/40423-17-P90
	16:13667	DOE/ER/40423-20
	16:13668	DOE/ER/40423-21
	16:13669	DOE/ER/40423-22
	16:13670	DOE/ER/40423-24
AS07-83NV10338	**University of Southwestern Louisiana, Lafayette, LA (USA)**	
	16:12397	DOE/NV/10338-1
AT03-76ER70023	**Stanford Linear Accelerator Center, Menlo Park, CA (USA)**	
	16:13335	SLAC-PUB-5365-Rev.

Contract No.	Abstract No.	Report No.
AT03-82ER12084	Stanford Univ., CA (USA). Dept. of Biological Sciences	
	16:13535	DOE/ER/12084–T1
FC03-85DP40200	Syracuse Univ., NY (USA). Dept. of Physics	
	16:13826	DOE/ER/18862–2
FC07-89ID12847	American Iron and Steel Inst., Washington, DC (USA)	
	16:13044	DOE/ID/12847–1
FC21-86MC11076	Western Research Inst., Laramie, WY (USA)	
	16:12355	DOE/MC/11076–2948
	16:12426	DOE/MC/11076–2951
	16:12428	DOE/MC/11076–2950
	16:12430	DOE/MC/11076–2949
FC21-88MC25048	Illinois Univ., Urbana, IL (USA). Dept. of Mechanical and Industrial Engineering	
	16:13321	DOE/MC/25048–2962
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	16:12402	NIPER–522-Vol.2
	16:13124	NIPER–488
FG01-82NE34082	Belgonucleaire SA, Brussels (Belgium)	
	16:12671	DOE/NE/34082–T3
	16:12672	DOE/NE/34082–T6
	16:12673	DOE/NE/34082–T7
	16:12674	DOE/NE/34082–T10
	16:12675	DOE/NE/34082–T13
	16:12676	DOE/NE/34082–T14
	16:12677	DOE/NE/34082–T15
	16:12678	DOE/NE/34082–T18
	16:12679	DOE/NE/34082–T19
	16:12680	DOE/NE/34082–T21
	16:12681	DOE/NE/34082–T24
	16:12682	DOE/NE/34082–T25
	16:12683	DOE/NE/34082–T26
	16:12684	DOE/NE/34082–T28
	16:12685	DOE/NE/34082–T30
	16:12686	DOE/NE/34082–T31
	16:12687	DOE/NE/34082–T32
	16:12688	DOE/NE/34082–T34
	16:12689	DOE/NE/34082–T35
	16:12690	DOE/NE/34082–T41
	16:12691	DOE/NE/34082–T45
	16:12692	DOE/NE/34082–T46
FG01-90CE21003	Texas A and M Univ., College Station, TX (USA). Energy Systems Lab.	
	16:12923	DOE/CE/21003–T2
FG02-84ER13252	Massachusetts Inst. of Tech., Cambridge, MA (USA)	
	16:13536	DOE/ER/13252–5
FG02-84ER45095	Pennsylvania State Univ., University Park, PA (USA)	
	16:13041	DOE/ER/45095–5
FG02-85ER13327	Indiana Univ.-Purdue Univ., Indianapolis, IN (USA)	
	16:13144	DOE/ER/13327–T2
FG02-85ER40235	Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Physics	
	16:13619	DOE/ER/40235–T6
FG02-85ER45188	Pennsylvania Univ., Philadelphia, PA (USA)	
	16:13042	DOE/ER/45188–T1
FG02-86ER13480	Princeton Univ., NJ (USA). Dept. of Chemistry	
	16:13145	DOE/ER/13480–1
FG02-86ER13580	Lehigh Univ., Bethlehem, PA (USA)	
	16:13165	DOE/ER/13580–1
FG02-86ER13597	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering	
	16:13612	DOE/ER/13597–T3
FG02-86ER13616	Indiana Univ., Bloomington, IN (USA). Dept. of Chemistry	
	16:13166	DOE/ER/13616–5
FG02-86ER40286	Iowa Univ., Iowa City, IA (USA). Dept. of Physics and Astronomy	
	16:13729	DOE/ER/40286–T3
FG02-86ER45252	Pennsylvania State Univ., University Park, PA (USA). Dept. of Materials Science and Engineering	
	16:13114	DOE/ER/45252–T5
FG02-86ER45258	Lehigh Univ., Bethlehem, PA (USA). Dept. of Physics	
	16:13115	DOE/ER/45258–91-01
FG02-86ER60460	Massachusetts Inst. of Tech., Cambridge, MA (USA)	
	16:13543	DOE/ER/60460–10
FG02-86NE37968	Tennessee Univ., Knoxville, TN (USA). Dept. of Electrical and Computer Engineering	
	16:12846	DOE/NE/37968–T1
FG02-87ER13670	Arizona Univ., Tucson, AZ (USA). Dept. of Physics	
	16:13593	DOE/ER/13670–2
FG02-87ER13690	Pennsylvania State Univ., University Park, PA (USA)	
	16:12582	DOE/ER/13690–3
FG02-87ER13744	Massachusetts Univ., Amherst, MA (USA). Dept. of Chemistry	
	16:13168	DOE/ER/13744–11
FG02-87ER13759	Purdue Univ., Lafayette, IN (USA). Heat Transfer Lab.	
	16:13040	DOE/ER/13759–4
FG02-87ER13792	Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Chemistry	
	16:13148	DOE/ER/13792–4
FG02-87ER40339	Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering	
	16:12572	DOE/ER/40339–4
FG02-87ER40342	Colorado School of Mines, Golden, CO (USA)	
	16:13775	DOE/ER/53276–3
FG02-87ER40362	Minnesota Univ., Minneapolis, MN (USA)	
	16:13697	DOE/ER/40362–4
FG02-87ER40370	Ohio Univ., Athens, OH (USA). Dept. of Physics and Astronomy	
	16:13706	DOE/ER/40370–T3
	16:13730	DOE/ER/40370–3
FG02-87ER45305	Arizona State Univ., Tempe, AZ (USA)	
	16:13092	DOE/ER/45305–1
FG02-87ER45310	Massachusetts Inst. of Tech., Cambridge, MA (USA)	
	16:13043	DOE/ER/45310–30
FG02-87ER60555	Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory	
	16:13588	DOE/ER/60555–4
FG02-87ER60556	Pennsylvania State Univ., University Park, PA (USA). Dept. of Agronomy	
	16:13548	DOE/ER/60556–T2
FG02-87ER60581	Colorado State Univ., Fort Collins, CO (USA)	
	16:13456	DOE/ER/60581–3
FG02-88ER13876	Princeton Univ., NJ (USA). Dept. of Chemistry	
	16:13169	DOE/ER/13876–1
FG02-88ER13966	Yale Univ., New Haven, CT (USA)	
	16:13197	DOE/ER/13966–2
FG02-88ER13969	Arizona State Univ., Tempe, AZ (USA). Dept. of Chemistry	
	16:13523	DOE/ER/13969–T1

Contract No.	Abstract No.	Report No.
FG02-88ER45347	Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Physics	
	16:13757	CONF-900866-2
FG02-88ER45356	Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemical Engineering	
	16:13089	CONF-901105-105
FG02-88ER45379	Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences	
	16:13026	DOE/ER/45379-2
FG02-88ER53269	Illinois Univ., Urbana, IL (USA)	
	16:13774	DOE/ER/53269-3
FG02-88ER53276	Colorado School of Mines, Golden, CO (USA)	
	16:13775	DOE/ER/53276-3
FG02-88ER60648	Pennsylvania State Univ., University Park, PA (USA). Dept. of Chemistry	
	16:13170	DOE/ER/60648-3
FG02-88ER60664	Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)	
	16:13457	DOE/ER/60664-6
FG02-88ER60678	Chicago Univ., IL (USA)	
	16:13555	DOE/ER/60678-3
FG02-88ER60687	Yale Univ., New Haven, CT (USA). School of Medicine	
	16:13525	DOE/ER/60687-T1
FG02-89CH10432	Illinois Univ., Chicago, IL (USA). Energy Resources Center	
	16:13419	DOE/CH/10432-1
FG02-89ER14042	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Electrical and Computer Engineering	
	16:13207	DOE/ER/14042-2
FG02-89ER45409	Utah Univ., Salt Lake City, UT (USA). Dept. of Physics	
	16:13116	DOE/ER/45409-1
FG02-89ER60784	Stockholm Univ. (Sweden). Dept. of Radiobiology	
	16:13571	DOE/ER/60784-2
FG02-90CE27504	Public Technology, Inc., Washington, DC (USA)	
	16:13009	DOE/CE/27504-1
FG02-90ER14125	Rochester Univ., NY (USA)	
	16:13344	DOE/ER/14125-1
FG02-90ER40566	State Univ. of New York, Buffalo, NY (USA). Dept. of Physics and Astronomy	
	16:13692	DOE/ER/40566-1
FG02-90ER45418	Michigan State Univ., East Lansing, MI (USA)	
	16:13090	CONF-901194-13
FG02-90ER45427	Purdue Univ., Lafayette, IN (USA)	
	16:13093	DOE/ER/45427-1-Pt.1
	16:13094	DOE/ER/45427-1-Pt.2
FG02-90ER53302	Pennsylvania State Univ., University Park, PA (USA). Dept. of Nuclear Engineering	
	16:13776	DOE/ER/53302-3
FG02-90ER60972	Ohio State Univ., Columbus, OH (USA)	
	16:13544	DOE/ER/60972-1
FG02-90ER61014	New York Univ., NY (USA). Dept. of Applied Science	
	16:13421	DOE/ER/61014-1
FG03-84ER13274	California Univ., Davis, CA (USA)	
	16:13642	CONF-8410224-14
FG03-85SF15927	Tufts Univ., Medford, MA (USA). Electro-Optics Technology Center	
	16:12925	DOE/SF/15927-T4
FG03-86ER13518	California Univ., Berkeley, CA (USA). Dept. of Plant Pathology	
	16:13537	DOE/ER/13518-5
FG03-86ER53220	California Univ., Berkeley, CA (USA). Electronics Research Lab.	
	16:13770	CONF-890931-14
	16:13810	UCB/ERL-M-90/67
FG03-86ER60395	California Univ., Berkeley, CA (USA). Dept. of Biochemistry	
	16:13524	DOE/ER/60395-T2
FG03-87ER13736	California Univ., Berkeley, CA (USA). Dept. of Molecular and Cell Biology	
	16:13522	DOE/ER/13736-T1
FG03-88ER13828	California Univ., Los Angeles, CA (USA). Dept. of Chemistry and Biochemistry	
	16:13530	UCLA-34P278-75
FG03-89ER14037	California Univ., Davis, CA (USA)	
	16:13538	DOE/ER/14037-T1
FG03-89ER51121	General Atomics, San Diego, CA (USA)	
	16:13832	GA-A-20280
	16:13834	GA-A-20317
FG03-90ER54079	California Univ., Berkeley, CA (USA). Electronics Research Lab.	
	16:13770	CONF-890931-14
FG03-90ER54088	Thermo Electron Technologies Corp., San Diego, CA (USA)	
	16:13777	DOE/ER/54088-1
FG03-90SF18437	Syracuse Univ., NY (USA). Dept. of Physics	
	16:13826	DOE/ER/18862-2
FG03-90SF18438	Maryland Univ., College Park, MD (USA). Lab. for Plasma Research	
	16:13828	DOE/SF/18438-1
FG03-91ER18862	Syracuse Univ., NY (USA). Dept. of Physics	
	16:13826	DOE/ER/18862-2
FG05-85ER13439	Rice Univ., Houston, TX (USA)	
	16:13196	DOE/ER/13439-6
FG05-85ER13456	Tennessee Univ., Knoxville, TN (USA). Dept. of Physics	
	16:13604	DOE/ER/13456-24
	16:13605	DOE/ER/13456-31
FG05-85ER40200	Oregon Univ., Eugene, OR (USA)	
	16:13657	DOE/ER/40224-151
	16:13658	DOE/ER/40224-152
FG05-85ER45194	Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemistry and Biochemistry	
	16:13113	DOE/ER/45194-6
FG05-85ER60348	Old Dominion Univ., Norfolk, VA (USA). Research Foundation	
	16:13587	DOE/ER/60348-T2
FG05-86ER13507	Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering	
	16:13146	DOE/ER/13507-6
FG05-86ER13591	Tennessee Univ., Knoxville, TN (USA)	
	16:13147	DOE/ER/13591-5
FG05-86ER13626	Texas Univ., Austin, TX (USA). Dept. of Chemistry	
	16:13167	DOE/ER/13626-4
FG05-87ER13708	Georgia Inst. of Tech., Atlanta, GA (USA). School of Physics	
	16:13345	DOE/ER/13708-T2
FG05-87ER40314	Lawrence Berkeley Lab., CA (USA)	
	16:13636	LBL-30144
FG05-87ER40319	Brookhaven National Lab., Upton, NY (USA)	
	16:13623	BNL-45843
FG05-87ER40321	Maryland Univ., College Park, MD (USA). Dept. of Chemistry and Biochemistry	
	16:13689	DOE/ER/40321-7
FG05-87ER40361	Tennessee Univ., Knoxville, TN (USA). Dept. of Physics and Astronomy	
	16:13690	DOE/ER/40361-1
	16:13691	DOE/ER/40361-4
	16:13711	CONF-9009135-9

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	16:13728	CONF-9005238–4
FG05-87ER52147	Maryland Univ., College Park, MD (USA)	
	16:13827	DOE/ER/52147–4
	Maryland Univ., College Park, MD (USA). Lab. for Plasma Research	
	16:13824	CONF-901248–2
	16:13825	CONF-9009166–19
FG05-88ER13897	Texas Univ., Austin, TX (USA). Center for Statistical Mechanics and Complex Systems	
	16:13763	CONF-9010321–1
	16:13764	DOE/ER/13897–12
FG05-88ER13943	Oak Ridge National Lab., TN (USA)	
	16:13164	CONF-9105137–1
FG05-88ER13971	Toledo Univ., OH (USA). Dept. of Physics and Astronomy	
	16:13606	DOE/ER/13971–7
FG05-88ER60721	Rice Univ., Houston, TX (USA). Dept. of Physics	
	16:13526	DOE/ER/60721–3
FG06-85ER13309	Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science	
	16:13263	DOE/ER/40224–184
FG06-85ER13389	Portland State Univ., OR (USA). Dept. of Chemistry	
	16:13112	DOE/ER/13389–3
FG06-85ER40224	Oregon Univ., Eugene, OR (USA)	
	16:13283	DOE/ER/40224–134
	16:13319	DOE/ER/40224–178
	16:13618	DOE/ER/40224–133
	16:13651	DOE/ER/40224–141
	16:13656	DOE/ER/40224–150
	16:13657	DOE/ER/40224–151
	16:13658	DOE/ER/40224–152
	16:13659	DOE/ER/40224–153
	16:13660	DOE/ER/40224–155
	16:13661	DOE/ER/40224–156
	16:13662	DOE/ER/40224–157
	Oregon Univ., Eugene, OR (USA). Dept. of Physics	
	16:13318	DOE/ER/40224–177
	16:13628	DOE/ER/40224–179
	Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science	
	16:13263	DOE/ER/40224–184
	16:13317	DOE/ER/40224–135
	16:13607	DOE/ER/40224–183
	16:13649	DOE/ER/40224–136
	16:13650	DOE/ER/40224–139
	16:13652	DOE/ER/40224–143
	16:13653	DOE/ER/40224–144
	16:13654	DOE/ER/40224–146
	16:13655	DOE/ER/40224–149
	16:13674	DOE/ER/40224–145
	16:13675	DOE/ER/40224–148
FG06-88ER25061	Washington Univ., Seattle, WA (USA). Dept. of Applied Mathematics	
	16:13613	DOE/ER/25061–9
FG06-88ER40402	Lawrence Berkeley Lab., CA (USA)	
	16:13717	LBL–29793
FG07-89ID12850	EG and G Idaho, Inc., Idaho Falls, ID (USA)	
	16:12614	DOE/ID/12850–4
FG08-85NV10461	Nevada Nuclear Waste Project Office, Carson City, NV (USA)	
	16:12476	DOE/NV/10461–T42
FG21-88MC11091	Kentucky Energy Cabinet Lab., Lexington, KY (USA)	
	16:12425	CONF-871198–
FG22-85PC80509	Delaware Univ., Newark, DE (USA). Dept. of Chemical Engineering	
	16:12306	DOE/PC/80509–T14
FG22-86PC90512	Colorado Univ., Boulder, CO (USA). Dept. of Chemical Engineering	
	16:12316	DOE/PC/90512–2942
FG22-87PC79917	Grambling State Univ., LA (USA). Dept. of Physics	
	16:12304	DOE/PC/79917–T6
FG22-87PC79922	North Carolina Univ., Chapel Hill, NC (USA). Dept. of Environmental Sciences and Engineering	
	16:12356	DOE/PC/79922–T6
FG22-87PC79930	Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering	
	16:12305	DOE/PC/79930–T5
FG22-88PC88922	Illinois Univ., Urbana, IL (USA). Dept. of Chemical Engineering	
	16:12322	DOE/PC/88922–10
FG22-88PC88928	Montana State Univ., Bozeman, MT (USA). Dept. of Mechanical Engineering	
	16:12912	DOE/PC/88928–T2
	Avco-Everett Research Lab., Inc., Everett, MA (USA)	
	16:13016	CONF-9006105–14
FG22-88PC88929	Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering	
	16:12307	DOE/PC/88929–T7
	16:12390	CONF-910424–3
FG22-88PC88939	Utah Univ., Salt Lake City, UT (USA). Dept. of Mining Engineering	
	16:12323	DOE/PC/88939–12
FG22-88PC88940	Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering	
	16:12308	DOE/PC/88940–T8
FG22-88PC88945	Tulsa Univ., OK (USA). Dept. of Chemical Engineering	
	16:12645	DOE/PC/88945–T4
FG22-89PC89762	Grambling State Univ., LA (USA)	
	16:12592	DOE/PC/89762–T3
FG22-89PC89775	Massachusetts Inst. of Tech., Cambridge, MA (USA)	
	16:12309	DOE/PC/89775–3
FG22-89PC89776	Northeastern Univ., Boston, MA (USA). Dept. of Chemical Engineering	
	16:12391	DOE/PC/89776–T1
FG22-89PC89777	Michigan State Univ., East Lansing, MI (USA). Dept. of Chemical Engineering	
	16:12310	DOE/PC/89777–T2
FG22-89PC89781	Cincinnati Univ., OH (USA). Coll. of Engineering	
	16:12311	DOE/PC/89781–5
FG22-90PC90096	Tulsa Univ., OK (USA). Center for Environmental Research and Technology	
	16:12357	DOE/PC/90096–1
FG22-90PC90169	BCR National Lab., Pittsburgh, PA (USA)	
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CONF-8810189–		(Commission of European Communities workshop on testing of high level waste forms under repository conditions; Cadarache (France); 17-21 Oct 1988)			
	16:13108	*See* CEA-CONF–10408			
	16:13109	*See* CEA-CONF–10409			
CONF-8810322–		(11. international conference on electroheat; Malaga (Spain); 3-7 Oct 1988)			
	16:13107	*See* CEA-CONF–10277			
CONF-8812153–		(20. NIRS symposium; Chiba (Japan); 8-9 Dec 1988)			
	16:13546	*See* NIRS-M–75			
CONF-8812154–		(16. NIRS seminar on environmental research; Chiba (Japan); 1-2 Dec 1988)			
	16:13750	*See* NIRS-M–76			
CONF-8904153–		(Symposium on nuclear dynamics and nuclear disassembly; Dallas, TX (USA); 9-14 Apr 1989)			
	16:13718	*See* LPCC–8903			
CONF-890554–		(3. world conference on neutron radiography; Osaka (Japan); 14-18 May 1989)			
	16:12832	*See* EUR–12727			
CONF-8906162–		(OECD seminar-workshop on NJOY and THEMIS and the NEA data bank; Saclay (France); 20-21 Jun 1989)			
	16:13693	*See* INIS-XN–305			
CONF-890617–		(2. Karlsruhe international conference on analytical chemistry in nuclear technology; Karlsruhe (Germany, F.R.); 5-9 Jun 1989)			
	16:12448	*See* CEA-CONF–9984			
CONF-8906267–		(TASI '89: Theoretical Advanced Summer Institute in elementary particle physics; Boulder, CO (USA); 4-30 Jun 1989)			
6	16:13628	*See* DOE/ER/40224–179			
CONF-8906314–		(Seminar on the results of R and D of nuclear power plants with WWER-1000 type light-water reactors; Karlovy Vary (Czechoslovakia); 6-9 Jun 1989)			
	16:12697	*See* INIS-mf–12781			
CONF-8906383–		(14. DOE solar photochemistry research conference; Lake Harmony, PA (USA); 3-7 Jun 1989)			
Summ.	16:13182	*See* BNL–52265			
CONF-8907218–		(Workshop on geological problems in radioactive waste isolation - a worldwide review; Washington, DC (USA); 15-16 Jul 1989)			
	16:12511	*See* LBL–29703			
CONF-890931–		(13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989)			
14	16:13770	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009831	MF-414
CONF-8910395–		(17. annual Illinois energy conference: environmental consequences of energy production; Chicago, IL (USA); 19-20 Oct 1989)			
	16:13419	*See* DOE/CH/10432–1			
CONF-891119–		(Materials Research Society fall meeting; Boston, MA (USA); 27 Nov - 2 dec 1989)			
145	16:12536	*See* UCRL–101323			
CONF-891120–		(Migration '89: 2nd international conference on chemistry and migration behavior of actinides and fission products in the geosphere; Monterey, CA (USA); 6-10 Nov 1989)			
	16:12473	*See* CEA-DAS–667			
CONF-8911282–		(ASCOPE '89: 4th ASEAN council on petroleum; Singapore (Singapore); 14-16 Nov 1989)			
1	16:12419	OSTI; Institute of Gas Technology, 3424 South State St., Chicago, IL 60616		TI91008389	
CONF-891130–		(3. international conference on processing and utilization of high-sulphur coals; Ames, IA (USA); 14-18 Nov 1989)			
6	16:12292	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008402	MF-109

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-891226–		(10. international conference on MHD electrical power generation; Tiruchirapalli (India); 4-8 Dec 1989)			
4	16:12913	*See* ETDE-IT–91-15			
CONF-9001120–		(International winter meeting on nuclear physics; Bormio (Italy); 22-26 Jan 1990)			
	16:13720	*See* LPCC–9001			
	16:13721	*See* LPCC–9002			
CONF-900135–		(15. general meeting of the Division of Particles and Fields of the American Physical Society (APS); Houston, TX (USA); 3-6 Jan 1990)			
21	16:13655	*See* DOE/ER/40224–149			
CONF-900203–		(Winter meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; Atlanta, GA (USA); 11-14 Feb 1990)			
7	16:12937	*See* LBL–28452			
CONF-9002171–		(SCOPE/IGBP workshop on trace gas exchange in a global perspective; Sigtuna (Sweden); 19-23 Feb 1990)			
1-Draft	16:12587	*See* ANL/CP–71780			
CONF-9002172–		(26. winter school of theoretical physics; Karpacz (Poland); 19 Feb - 3 mar 1990)			
1	16:13084	*See* ANL/CP–71423			
CONF-9003115–		(17. annual day of scientific lectures and 13. annual meeting of the National Society of Black Physicists; Baton Rouge, LA (USA); 21-24 Mar 1990)			
	16:13592	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009432	MF-410
CONF-9003150–		(5. international conference on instrumentation for colliding beam physics; Novosibirsk (USSR); 15-21 Mar 1990)			
	16:13342	*See* DESY–90-109			
CONF-9003161–		(25. Rencontres de Moriond on QCD and hadronic interactions conference; Les Arcs (France); 4-11 Mar 1990)			
13	16:13677	*See* ANL-HEP-CP–90-58			
CONF-9003162–		(Santa Fe workshop on intermittency in high energy collisions; Santa Fe, NM (USA); 18-21 Mar 1990)			
3	16:13656	*See* DOE/ER/40224–150			
4	16:13658	*See* DOE/ER/40224–152			
CONF-9003177–		(International workshop on rare decays of light mesons; Gif-sur-Yvette (France); 29-30 Mar 1990)			
	16:13282	*See* CEA-CONF–10422			
CONF-9003229–		(French language colloquium on phase transitions; Djerba, TN (USA); 19-24 Mar 1990)			
	16:13087	*See* CEA-CONF–10421			
CONF-9003245–		(Giornata di studio sulla pubblicazione 54 dell'ICRP; Bologna (Italy); 6 Mar 1990)			
1	16:13556	*See* ENEA-RT-AMB–90-09			
CONF-900402–		(199. national meeting of the American Chemical Society; Boston, MA (USA); 22-27 Apr 1990)			
12	16:12293	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008401	
CONF-900418–		(International conference on the physics of reactors: operation, design and computation; Marseilles (France); 23-27 Apr 1990)			
17	16:12803	*See* ETDE-IT–91-17			
CONF-9004182–		(17. environmental symposium of the American defense preparedness association: environmental compliance and enforcement at DOD installations in the 1990's; Atlanta, GA (USA); 17-20 Apr 1990)			
4	16:12946	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008400	
CONF-9004232–		(Prospects for a 1 Angstrom Free-Electron Laser (FEL) workshop; Sag Harbor, NY (USA); 22-27 Apr 1990)			
6	16:13244	*See* BNL–45824			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9004261–		(Workshop on can RHIC be used to test QED; Upton, NY (USA); 20-21 Apr 1990)			
Summ.	16:13622	*See* BNL–45842			
CONF-9004280–		(Vancouver industrial gas '90 conference; Vancouver (UK); 18 Apr 1990)			
1-Vugraphs	16:12424	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008390	
CONF-9004281–		(Asian natural gas II - a brighter '90s; Singapore (Singapore); 9-11 Apr 1990)			
1	16:12921	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008380	
2	16:12653	OSTI; Inst. of Gas Technology, 3424 S. State St., Chicago, IL 60616		TI91008397	
CONF-9004282–		(Operation and maintenance of nuclear power plant; Nove Mesto na Morave (Czechoslovakia); 24-26 Apr 1990)			
	16:12725	*See* INIS-mf–12796			
CONF-9004285–		(IAEA Specialists' Meeting on Communication and Data Transfer in Nuclear Power Plants; Lyon (France); 24-26 Apr 1990)			
	16:12663	*See* CEA-CONF–10410			
CONF-900432–		(Science and technology of thin-film superconductors conference; Denver, CO (USA); 30 Apr - 4 may 1990)			
2	16:13086	*See* BNL–43779			
CONF-900505–		(9. plasma surface interactions in controlled fusion devices conference; Bournemouth (UK); 20-25 May 1990)			
14	16:13782	*See* ETDE-IT–91-07			
CONF-9005238–		(Symposium in honor of Akito Arima: nuclear physics in the 1990's; Santa Fe, NM (USA); 1-5 May 1990)			
4	16:13728	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008609	MF-413
CONF-9005245–		(International workshop on correlations and multiparticle production (CAMP); Marburg (Germany, F.R.); 14-16 May 1990)			
6	16:13661	*See* DOE/ER/40224–156			
CONF-9005251–		(Workshop on quark-gluon structure of hadrons and nuclei; Shanghai (China); 28 May - 1 jun 1990)			
2	16:13683	*See* LA-UR–91-662			
CONF-9005313–		(1990 conference on muon catalyzed fusion; Vienna (Austria); 28 May - 1 jun 1990)			
2	16:13700	*See* LA-UR–91-786			
CONF-9005316–		(International seminar on common threads in mathematics and quantum field theory; Kyoto (Japan); 10-22 May 1990)			
1	16:13620	*See* LBL–29470			
CONF-9005317–		(Gas Research Institute (GRI) workshop on plastic pipe location; Chicago, IL (USA); 1-2 May 1990)			
1	16:12418	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008398	
CONF-9005322–		(22nd international symposium on automotive technology & automation; Florence (Italy); 14 May 1990)			
1	16:13045	*See* ENEA-RT-INN–90-08			
CONF-9005324–		(Satellite workshop of the 9th PSI conference; Cadarache (France); 28-30 May 1990)			
	16:13843	*See* Juel–2378			
CONF-900534–		(18. NATO/CCMS international technical meeting on air pollution modelling and its applications; Vancouver (Canada); 13-17 May 1990)			
5	16:13428	*See* GKSS–90/E/24			
CONF-900546–		(4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990)			
Absts.	16:12318	*See* ORNL/M–1165			
CONF-900570–		(8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90; Menton (France); 7-11 May 1990)			
15-Rev.	16:13716	*See* LBL–29578-Rev.			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900601–		(12. PANIC international conference on particles and nuclei; Cambridge, MA (USA); 24-29 Jun 1990)			
25	16:13663	*See* DOE/ER/40423–12-P90			
CONF-900603–		(EPAC '90: 2nd European particle accelerator conference ACROPOLIS; Nice (France); 11-16 Jun 1990)			
	16:13264	*See* GANIL-A–9007			
	16:13289	*See* GANIL-A–9004			
	16:13290	*See* GANIL-A–9005			
60	16:13274	*See* LBL–29233			
61	16:13266	*See* LBL–29232			
CONF-9006105–		(28. symposium on engineering aspects of magnetohydrodynamics; University coal research and historically black colleges and universities contractors review; Chicago, IL (USA); Pittsburgh, PA (USA); 26-28 Jun 1990; 16-19 jul 1990)			
14	16:13016	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008561	MF-112
CONF-9006119–		(Hazardous waste and environmental management in the gas industry; Chicago, IL (USA); 11-13 Jun 1990)			
1	16:12947	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008384	
CONF-900617–		(1990 pressure vessels and piping conference; Nashville, TN (USA); 17-21 Jun 1990)			
Pt.1	16:12861	*See* NUREG/CP–0037			
CONF-9006220–		(28. COSPAR plenary conference; The Hague (Netherlands); 25 Jun - 6 jul 1990)			
6	16:13598	*See* KFKI–1990-27/C			
CONF-9006235–		(114. enrico fermi school of physics; La Specia (Italy); 19-29 Jun 1990)			
2	16:13277	*See* ANL/CP–70732			
CONF-9006242–		(Workshop on short pulse high current cathodes; Bendor (France); 18-22 Jun 1990)			
4	16:13602	OSTI; NTIS (US Sales Only)		DE91009151	
6	16:13754	*See* BNL–45443			
5-Vugraphs	16:13758	OSTI; NTIS (US Sales Only)		DE91009150	
CONF-9006267–		(1990 DPF summer study on high energy physics; Snowmass, CO (USA); 25 Jun - 13 jul 1990)			
24	16:13673	*See* SLAC-PUB–5419			
25	16:13590	*See* ANL-HEP-CP–90-106			
26	16:13276	*See* SLAC-PUB–5436			
27	16:13631	*See* FNAL/C–91/25-E			
28	16:13621	*See* BNL–45828			
CONF-9006268–		(10. international conference on physics in collision; Durham, NC (USA); 21-23 Jun 1990)			
6	16:13632	*See* FNAL/C–91/26-E			
CONF-9006275–		(Workshop on physics and detector issues for a high-luminosity asymmetric B factory; Stanford, CA (USA); 4-8 Jun 1990)			
3	16:13643	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009198	MF-414
CONF-9006319–		(IAEA consultants meeting on first results of Fusion Evaluated Nuclear Data Library (FENDL-1) testing and start of FENDL-2; Vienna (Austria); 25-28 Jun 1990)			
	16:13838	*See* INDC(NDS)–241/LF			
CONF-9006321–		(Scientical days. ASST, SIA, EPFL: nuclear energy, LMFBR and engineer ethics; Lausanne (Switzerland); 26-27 Jun 1990)			
	16:12843	*See* CEA-DAS–724			
CONF-9006322–		(Seminar on peat research: Polytechnical Institute of Kalinin and University of Oulu; Oulu (Finland); 6 Jun 1990)			
	16:12364	*See* OY/PSTL-RR–102			
CONF-9006327–		(6. IAERU seminar, 'reactor chemistry'; Tokyo (Japan); 9 Jun 1990)			
	16:13190	*See* IAERU–9002			

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CONF-900710–		(IAEA symposium on balancing automation and human action in nuclear power plants; Munich (Germany, F.R.); 9-13 Jul 1990)			
	16:12823	*See* CEA-DAS–729			
CONF-9007123–		(ISEC'90: International Solvent Extraction Conference; Kyoto (Japan); 16-21 Jul 1990)			
2	16:12447	*See* ANL/CP–71262			
CONF-9007149–		(39. annual Denver x-ray conference; Steamboat Springs, CO (USA); 30 Jul - 3 aug 1990)			
6	16:13039	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008874	MF-404
CONF-9007180–		(1990 international workshop on strong coupling gauge theories and beyond; Nagoya (Japan); 28-31 Jul 1990)			
	16:13679	*See* DESY–90-104			
CONF-9007202–		(Workshop on energy conservation and industrial and commercial aplications of heat pumps; Cuernavaca (Mexico); 4-6 Jul 1990)			
1	16:12922	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008388	
CONF-9007204–		(Workshops on the utilization of electron beams; Workshops on the utilization of electron beams; Bangi (Malaysia); Jakarta (Indonesia); 17 Jul 1990; 20 jul 1990)			
	16:12574	*See* JAERI-M–90-194			
CONF-9007205–		(Workshops on the utilization of electron beams; Workshops on the utilization of electron beams; Bangi (Malaysia); Jakarta (Indonesia); 17 Jul 1990; 20 jul 1990)			
	16:12574	*See* JAERI-M–90-194			
CONF-9007206–		(7. International School of Intermediate Energy Nuclear Physics; L'Aquila (Italy); 16-26 Jul 1990)			
	16:13262	*See* CEA-LNS-Ph–90-46			
CONF-900722–		(8. international conference on ion implantation technology; Guildford (UK); 30 Jul - 3 aug 1990)			
1	16:13761	*See* LBL–28685			
CONF-900749–		(28. symposium on engineering aspects of magnetohydrodynamics; University coal research and historically black colleges and universities contractors review; Chicago, IL (USA); Pittsburgh, PA (USA); 26-28 Jun 1990; 16-19 jul 1990)			
1	16:13016	*See* CONF-9006105–14			
CONF-900756–		(34. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA (USA); 8-13 Jul 1990)			
58	16:13591	*See* BNL–45580			
59	16:13755	*See* BNL–45578			
CONF-900757–		(X-90: 15th international conference on X-ray and inner-shell processes; Knoxville, TN (USA); 9-13 Jul 1990)			
8	16:13265	*See* LBL–28729			
CONF-900772–		(4. workshop on experiments and detectors for a relativistic heavy ion collider; Upton, NY (USA); 2-7 Jul 1990)			
10	16:13309	*See* BNL–45841			
CONF-900801–		(25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990)			
41	16:12294	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008393	
42	16:12295	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008395	MF-109
44	16:12375	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008399	
CONF-900804–		(International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990)			
	16:12782	*See* CEA-DAS–728			

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CONF-900807--		(Joint Varenna-Lausanne international workshop on theory of fusion plasmas; Varenna (Italy); 27-31 Aug 1990)			
	16:13802	*See* LRP--411/90			
CONF-900814--		(7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990)			
17	16:13835	*See* GA-A--20330			
CONF-9008152--		(Predeal international summer school on recent advances in nuclear structure; Predeal (Romania); 28 Aug - 8 sep 1990)			
	16:13731	*See* GSI--90-67(prepr.)			
CONF-9008196--		(4. international conference on high pressure in semiconductor physics; Porto Carras (Greece); 11-13 Aug 1990)			
1	16:13123	*See* LBL--29888			
CONF-900822--		(25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990)			
	16:13635	*See* LAL--9035			
30	16:13630	*See* FNAL/C--90/271-E			
CONF-900859--		(7. U.S./Korea workshop on coal utilization technology meeting; Pittsburgh, PA (USA); 26-31 Aug 1990)			
1	16:12301	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008387	MF-109; MF-105
2	16:12302	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008386	MF-109
3	16:12389	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008547	MF-113
CONF-900866--		(20. international Union of Pure and Applied Physics of semiconductors; Thessaloniki (Greece); 6-10 Aug 1990)			
2	16:13757	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009353	MF-410
CONF-900870--		(10. international symposium on boron, borides and related compounds; Albuquerque, NM (USA); 27-30 Aug 1990)			
9	16:13104	*See* SAND--90-2308C			
10	16:13103	*See* SAND--89-2869C			
CONF-9009123--		(1990 Linear accelerator conference; Albuquerque, NM (USA); 9-14 Sep 1990)			
	16:13260	*See* LA--12004-C			
66	16:13284	*See* FNAL/C--91/38			
67	16:13286	*See* FNAL/C--91/47			
68	16:13285	*See* FNAL/C--91/44			
69	16:13272	*See* FNAL/C--91/39			
CONF-9009135--		(International conference on high spin physics and gamma-soft nuclei; Pittsburgh, PA (USA); 17-21 Sep 1990)			
9	16:13711	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008610	MF-413
CONF-9009141--		(International symposium on metal-hydrogen systems; Banff (Canada); 2-7 Sep 1990)			
11	16:12569	*See* WSRC-RP--89-1315			
CONF-9009165--		(12. international free electron laser conference (FEL-12); Paris (France); 17-21 Sep 1990)			
19	16:13825	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008319	MF-421
20	16:13267	*See* LBL--29957			
CONF-900917--		(American Nuclear Society (ANS) topical meeting on safety of commercial nuclear reactor research and irradiation facilities; Boise, ID (USA); 30 Sep - 3 oct 1990)			
34	16:12869	*See* WSRC-MS--90-12			
35	16:12870	*See* WSRC-MS--90-15			
36	16:12871	*See* WSRC-RP--89-1390			
CONF-9009198--		(Annual conference of the Hazardous Materials Control Research Institute (HMCRI): Great Lakes '90; Cleveland, OH (USA); 26-28 Sep 1990)			
1	16:13238	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008385	

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CONF-900924–		(9. international symposium on high energy spin-physics; Bonn (Germany, F.R.); 10-15 Sep 1990)			
15	16:13676	*See* LBL–29780			
CONF-9009266–		(2. international colloquium on X-ray lasers; York (UK); 17-21 Sep 1990)			
10-Rev.1	16:13255	*See* UCRL-JC–104407-Rev.1			
11	16:13531	*See* UCRL-JC–104229			
CONF-9009269–		(32. annual meeting of the American Physical Society - Division of Plasma Physics (APS/DPP); US-Japan workshop on advances in simulation techniques applied to plasmas and fusion; Cincinnati, OH (USA); Los Angeles, CA (USA); 12-16 Nov 1990; 26-28 sep 1990)			
8	16:13813	*See* UCRL-JC–105124			
CONF-9009293–		(5. annual conference on hydrocarbon contaminated soils; Amherst, MA (USA); 24-27 Sep 1990)			
2	16:13487	*See* UCRL–102799			
CONF-9009295–		(2. workshop on verification of arms reduction; Vienna (Austria); 3-5 Sep 1990)			
2	16:13025	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007752	MF-700
CONF-9009303–		(Workshop on graphical user interfaces in computational chemistry; Seattle, WA (USA); 5-7 Sep 1990)			
1	16:13139	*See* PNL-SA–18847			
CONF-9009309–		(Rheinfels workshop on hadron mass spectrum; St. Goar (Germany, F.R.); 3-6 Sep 1990)			
8	16:13626	*See* BNL–45847			
9	16:13625	*See* BNL–45846			
10	16:13624	*See* BNL–45845			
12	16:13623	*See* BNL–45843			
CONF-9009337–		(International Dawson symposium on the physics of plasma; Los Angeles, CA (USA); 24-25 Sep 1990)			
1	16:13858	*See* UCRL-JC–105830			
2	16:13815	*See* UCRL-JC–105829			
CONF-9009339–		(International workshop on high density nuclear matter; Ibaraki (Japan); 18-21 Sep 1990)			
2	16:13739	*See* LBL–30129			
CONF-9009342–		(International symposium on engineering turbulence modelling and measurements; Dubrovnik (Yugoslavia); 24-28 Sep 1990)			
	16:12662	*See* SV-S–90-5			
CONF-9009343–		(2. London conference on position-sensitive detectors; London (UK); 4-7 Sep 1990)			
	16:13332	*See* NIKHEF-H–90-13			
CONF-9009345–		(American Nuclear Society (ANS) conference on facility operations: safeguards interface; Albuquerque, NM (USA); 29 Sep 1990)			
1	16:12566	*See* SAND–91-0190C			
CONF-9009346–		(Committee on the Safety of Nuclear Installations (CSNI) on Probabilistic Safety Assessment (PSA) applications and limitations; Santa Fe, NM (USA); 4-6 Sep 1990)			
	16:12664	*See* CEA-DAS–731			
	16:12862	*See* NUREG/CP–0115			
CONF-9009347–		(Conference on mechanism of non-uniform combustion; Tokyo (Japan); 10-11 Sep 1990)			
1	16:12417	*See* UCRL-JC–105417			
CONF-9009348–		(DYNA3D users group conference; Bournemouth (UK); 18-19 Sep 1990)			
1	16:13225	*See* UCRL-JC–104826			
CONF-9009350–		(Radionuclide adsorption workshop; Los Alamos, NM (USA); 11-12 Sep 1990)			
1	16:13454	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008873	MF-402
CONF-9009351–		(ICASE workshop: heterogeneous boundary condition; Hampton, VA (USA); 26-28 Sep 1990)			
1	16:13615	*See* LA-UR–91-589			

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CONF-9009352–		(9. convegno nazionale di relativita generale; Capri (Italy); 25-28 Sep 1990)			
1	16:13682	*See* INFN/AE–90/14			
CONF-9009359–		(5. symposium: Computer science for environmental protection; Vienna (Austria); 19-21 Sep 1990)			
1	16:13417	*See* FAW-TR–90010			
CONF-9009361–		(Commission of the European Communities Working Group on the Safety of Thermal reactors; Brussels (Belgium); 26-27 Sep 1990)			
	16:12666	*See* CEA-DAS–742			
CONF-9009363–		(22. General assembly of the european seismological commission; Barcelona (Spain); 17-22 Sep 1990)			
	16:13582	*See* CEA-DAS–739			
CONF-9009364–		(Extraction'90 Meeting; Dounreay (UK); 10-14 Sep 1990)			
	16:12449	*See* CEA-CONF–10432			
	16:12450	*See* CEA-CONF–10434			
	16:12472	*See* CEA-CONF–10433			
CONF-900970–		(International conference on Monte Carlo methods in neutron and photon transport; Budapest (Hungary); 25-28 Sep 1990)			
5	16:13829	*See* ETDE-IT–91-08			
CONF-900980–		(3. ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century; Lyon (France); 23-28 Sep 1990)			
	16:12668	*See* CEA-DAS–745			
	16:12669	*See* CEA-DAS–746			
	16:12802	*See* CEA-DAS–744			
CONF-901007–		(9. topical meeting on technology of fusion energy; Oak Brook, IL (USA); 7-11 Oct 1990)			
6	16:13852	*See* UCRL-JC–103816-Rev.1			
61	16:13833	*See* GA-A–20299			
62	16:13817	*See* ANL/CP–70535			
CONF-9010128–		(14. Europhysics conference on nuclear physics: rare nuclear decays and fundamental processes; Bratislava (Czechoslovakia); 22-26 Oct 1990)			
4	16:13636	*See* LBL–30144			
CONF-9010146–		(22. annual symposium on optical materials for high power lasers; Boulder, CO (USA); 24-26 Oct 1990)			
3	16:13101	*See* PNL-SA–18588			
CONF-9010152–		(Microcontamination '90 conference; Santa Clara, CA (USA); 30 Oct - 1 nov 1990)			
2	16:13130	*See* SAND–90-2540C			
CONF-9010197–		(American flame research committee 1990 fall international symposium; San Francisco, CA (USA); 8-10 Oct 1990)			
3	16:13239	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008383	
CONF-9010212–		(Symposium on detector research and development for the Superconducting Super Collider; Fort Worth, TX (USA); 15-18 Oct 1990)			
36	16:13340	*See* UCRL-JC–105645			
37	16:13341	*See* UCRL-JC–105646			
38	16:13308	*See* BNL–45840			
39	16:13319	*See* DOE/ER/40224–178			
40	16:13318	*See* DOE/ER/40224–177			
41	16:13330	*See* LBL–30222			
CONF-9010214–		(NEA workshop on flow heterogeneity and site evaluation; Paris (France); 22-24 Oct 1990)			
2	16:12513	*See* LBL–30146			
CONF-9010220–		(1990 IEEE nuclear science symposium; Arlington, VA (USA); 23-27 Oct 1990)			
13	16:13335	*See* SLAC-PUB–5365-Rev.			
27	16:13329	*See* LBL–29057			
28	16:13328	*See* LBL–29055			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-901024–		(2. international conference on containment design and operation; Toronto (Canada); 14-17 Oct 1990)			
	16:12665	*See* CEA-DAS–740			
CONF-9010243–		(International collaboration on advanced neutron sources; Tsukuba (Japan); 21-26 Oct 1990)			
13	16:12571	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007657	MF-404
CONF-9010249–		(International symposium on trends in biological dosimetry; Lerici (Italy); 23-27 Oct 1990)			
3-Rev.1	16:13578	*See* UCRL-JC–104810			
CONF-901025–		(13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990)			
32	16:13821	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005489	MF-420
33	16:13771	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005488	MF-420
34	16:13822	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005490	MF-420
35	16:13772	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005491	MF-421
36	16:13773	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005459	MF-420
37	16:13823	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005474	MF-423
41	16:13784	*See* GA-A–20272			
42	16:13785	*See* GA-A–20277			
43	16:13832	*See* GA-A–20280			
44	16:13786	*See* GA-A–20281			
45	16:13834	*See* GA-A–20317			
46	16:13787	*See* GA-A–20283			
CONF-9010254–		(32. annual meeting on Pyrotechnics and Explosives Applications Section (ADPA); Albuquerque, NM (USA); 2-4 Oct 1990)			
2	16:13200	*See* SAND–90-1851C			
CONF-9010264–		(Los Alamos Meson Physics Facility (LAMPF) workshop; Los Alamos, NM (USA); 11-13 Oct 1990)			
9	16:13696	*See* LA-UR–91-514			
CONF-9010266–		(Conference on anomalous nuclear effects in deuterium/solid systems; Provo, UT (USA); 22-24 Oct 1990)			
2	16:13327	*See* LA-UR–91-339			
CONF-9010267–		(1990 workshop on accelerator instrumentation; Batavia, IL (USA); 1-4 Oct 1990)			
3	16:13298	*See* LA-UR–91-532			
CONF-9010271–		(International seminar on future perspectives in HEP; Protvino (USSR); 6-8 Oct 1990)			
3	16:13269	*See* SLAC-PUB–5347			
CONF-9010276–		(International workshop on accelerators for asymmetric B-factories; Tsukuba (Japan); 4-6 Oct 1990)			
3	16:13299	*See* LBL–29622			
CONF-9010297–		(34. Robert A. Welch Foundation conference on chemical research: fifty years with transuranium elements; Houston, TX (USA); 22-23 Oct 1990)			
3	16:13192	*See* LBL–29815			
CONF-9010298–		(International workshop on radiative properties of hot dense matter; Sarasota, FL (USA); 22-26 Oct 1990)			
6	16:13861	*See* UCRL-JC–106737			
CONF-9010299–		(International symposium on heavy ion physics and its applications; Lanzhou (China); 7-13 Oct 1990)			
	16:13714	*See* GANIL-P–9018			
3	16:13717	*See* LBL–29793			
CONF-9010316–		(Photovoltaic module reliability workshop; Lakewood, CO (USA); 25-26 Oct 1990)			
	16:12603	*See* SERI/CP–213-4079			
CONF-9010321–		(26. nobel conference; St. Peter, MN (USA); 2-3 Oct 1990)			
1	16:13763	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008316	MF-410
CONF-9010322–		(Chem-Tech 90; New Delhi (India); 6-12 Oct 1990)			
1	16:12420	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008382	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9010324–		(International Atomic Energy Agency (IAEA) consultants meeting on nuclear emission in the fission process; Vienna (Austria); 22-24 Oct 1990)			
1	16:13738	*See* LA-UR–91-437			
CONF-9010326–		(Nuclear cold fusion conference; Provo, UT (USA); Oct 1990)			
1	16:13846	*See* LA-UR–91-631			
CONF-9010328–		(International conference on activation analysis and its applications; Beijing (China); 15 Oct 1990)			
1	16:13830	*See* ETDE-IT–91-12			
2	16:13151	*See* ETDE-IT–91-05			
CONF-9010333–		(IAEA specialists meeting on analysis and experience in control and instrumentation; Arnhem (Netherlands); 16-19 Oct 1990)			
	16:12667	*See* CEA-DAS–743			
CONF-9010334–		(Rencontre STA-SCSIN, science and technology agency; Tokyo (Japan); 8-12 Oct 1990)			
	16:12783	*See* CEA-DAS–730			
CONF-901072–		(LATTICE '90: 7th international lattice gauge theory conference; Tallahassee, FL (USA); 8-12 Oct 1990)			
11	16:13667	*See* DOE/ER/40423–20			
12	16:13668	*See* DOE/ER/40423–21			
CONF-901073–		(178. meeting of the Electrochemical Society (ECS); Seattle, WA (USA); 14-19 Oct 1990)			
16	16:12915	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008381	
CONF-901105–		(Fall meeting of the Materials Research Society; Boston, MA (USA); 24 Nov - 1 dec 1990)			
100	16:13080	*See* UCRL-JC–104594			
101	16:13083	*See* UCRL-JC–106152			
102	16:13081	*See* UCRL-JC–106136			
103	16:13128	*See* PNL-SA–18622			
104	16:13088	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008887	MF-404
105	16:13089	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008980	MF-401
106	16:13126	*See* PNL-SA–18586			
107	16:13127	*See* PNL-SA–18587			
108	16:12512	*See* LBL–29867			
97	16:13136	*See* UCRL-JC–106127			
98	16:13079	*See* UCRL-JC–104591			
99	16:13082	*See* UCRL-JC–106151			
CONF-9011127–		(32. annual meeting of the American Physical Society - Division of Plasma Physics (APS/DPP); US-Japan workshop on advances in simulation techniques applied to plasmas and fusion; Cincinnati, OH (USA); Los Angeles, CA (USA); 12-16 Nov 1990; 26-28 sep 1990)			
17	16:13813	*See* UCRL-JC–105124			
CONF-9011149–		(1990 nuclear explosives code developers' conference; Monterey, CA (USA); 6-9 Nov 1990)			
12	16:13743	*See* UCRL-JC–105542			
13	16:13923	*See* SAND–92-0402C			
14	16:13855	*See* UCRL-JC–105123			
15	16:13814	*See* UCRL-JC–105616			
CONF-9011155–		(9. international congress on he applications of lasers and electro-optics: ICALEO '90; Boston, MA (USA); 4-9 Nov 1990)			
2	16:13254	*See* UCRL-JC–104394			
CONF-9011184–		(1990 international symposium on heavy ion fusion; Monterey, CA (USA); 6-9 Nov 1990)			
1	16:13853	*See* UCRL-JC–104365			
CONF-901141–		(International conference on trends in astroparticle physics; Santa Monica, CA (USA); 26 Nov - 1 dec 1990)			
2	16:13594	*See* FNAL/C–91/51-A			
3	16:13596	*See* FNAL/C–91/61-A			

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CONF-901144–		(Vacuum design of advanced synchrotron light sources; Argonne, IL (USA); 13-15 Nov 1990)			
2	16:13300	*See* LBL–29822			
3	16:13303	*See* LBL–29823			
CONF-901194–		(American Society of Mechanical Engineers (ASME) winter annual meeting; Dallas, TX (USA); 25-30 Nov 1990)			
13	16:13090	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008516	MF-404
14	16:13060	*See* LBL–29614			
CONF-901202–		(Ultrasonics symposium; Honolulu, HI (USA); 5-7 Dec 1990)			
1	16:13756	*See* BNL–45888			
CONF-901219–		(International symposium on heavy ion inertial fusion; Monterey, CA (USA); 3-6 Dec 1990)			
10	16:13854	*See* UCRL-JC–104984-R1			
11	16:13856	*See* UCRL-JC–105344			
CONF-901248–		(15. international conference on infrared and millimeter waves; Lake Buena Vista, FL (USA); 10-14 Dec 1990)			
2	16:13824	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008318	MF-421
CONF-901263–		(International conference on lasers '90; San Diego, CA (USA); 10-14 Dec 1990)			
8	16:13847	*See* LA-UR–91-728			
CONF-901275–		(Gamma-ray line astrophysics symposium; Paris (France); 10-13 Dec 1990)			
1	16:13600	*See* UCRL-JC–105999			
CONF-901281–		(International symposium on geotomography; Tokyo (Japan); 10-11 Dec 1990)			
1	16:13349	*See* LBL–30081			
CONF-901282–		(NATO advanced research workshop: Observational tests of inflation; Durham (UK); 10-14 Dec 1990)			
1	16:13595	*See* FNAL/C–91/53-A			
CONF-910116–		(8. symposium on space nuclear power systems; Albuquerque, NM (USA); 6-10 Jan 1991)			
20	16:12914	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008131	MF-706
CONF-910123–		(OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium; Los Angeles, CA (USA); 20-25 Jan 1991)			
1	16:13191	*See* LA-UR–91-147			
5	16:13176	*See* LA-UR–91-409			
6	16:13527	*See* LA-UR–91-361			
11	16:13258	*See* UCRL-JC–105613			
13	16:13519	*See* UCRL-JC–105391			
14	16:13859	*See* UCRL-JC–106275			
15	16:13860	*See* UCRL-JC–106277			
16	16:13529	*See* LA-UR–91-562			
CONF-910135–		(7. winter workshop on nuclear dynamics; Key West, FL (USA); 27 Jan - 2 feb 1991)			
1	16:13712	*See* BNL–45852			
CONF-910145–		(Electronic structure and mechanisms for high temperature superconductivity; Coral Gables, FL (USA); 3-9 Jan 1991)			
1	16:13762	*See* LA-UR–91-567			
CONF-910162–		(15. annual conference on composites and advanced ceramics; Cocoa Beach, FL (USA); 13-16 Jan 1991)			
4	16:13102	*See* PNL-SA–18908			
5	16:13110	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009134	MF-316
6	16:13091	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009122	MF-332
CONF-910169–		(International panel on 14 MeV intense neutron source based on accelerators for fusion metals studies; Tokyo (Japan); 14-16 Jan 1991)			
3	16:13862	*See* WHC-SA–1068			
CONF-910186–		(Engineering Foundation conference; Santa Barbara, CA (USA); 1-11 Jan 1991)			
2	16:13137	*See* UCRL-JC–106518			

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CONF-910189–		(Society for Industrial and Applied Mathematics (SIAM) workshop on automatic differentiation of algorithms: theory, implementation, and application; Breckenridge, CO (USA); 6-8 Jan 1991)			
1	16:13878	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009561	MF-705
CONF-910202–		(Annual meeting and exhibition of the Minerals, Metals and Materials Society; New Orleans, LA (USA); 17-21 Feb 1991)			
4	16:13085	*See* ANL/CP–72495			
6	16:13059	*See* LA-UR–91-610			
7	16:13125	*See* PNL-SA–18545			
CONF-910207–		(Meeting on parallel methods on large-scale structural analysis and physics applications; Hampton, VA (USA); 5-6 Feb 1991)			
3	16:13919	*See* SAND–90-1706C			
CONF-910208–		(Annual meeting of the American Association for the Advancement of Science: earth science; Washington, DC (USA); 15-19 Feb 1991)			
1	16:13024	*See* PNL-SA–18728			
CONF-910223–		(4. topical meeting on robotics and remote systems; Albuquerque, NM (USA); 24-28 Feb 1991)			
13	16:12565	*See* UCRL-JC–105782			
CONF-910229–		(6. Lake Louise winter institute (LLWI-6): topical workshop on particle physics - the factory era; Lake Louise (Canada); 17-22 Feb 1991)			
2	16:13639	*See* SLAC-PUB–5428			
CONF-910247–		(International conference on research trends in inertial confinement fusion; La Jolla, CA (USA); 4-6 Feb 1991)			
1	16:13857	*See* UCRL-JC–105733			
CONF-910265–		(Texas Center for Superconductivity workshop on the physics and mathematics of anyons; Houston, TX (USA); 1-2 Feb 1991)			
1	16:13768	*See* LA-UR–91-633			
CONF-910270–		(Waste management '91; Tucson, AZ (USA); 24-28 Feb 1991)			
7	16:12531	*See* SAND–90-2342C			
9	16:13220	*See* SAND–90-2526C			
15	16:13221	*See* SAND–90-2527C			
16	16:12884	*See* PNL-SA–19148			
17	16:12474	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008368	MF-721
18	16:12475	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008392	MF-721
19	16:12465	*See* PNL-SA–18999			
20	16:12564	*See* PNL-SA–19002			
21	16:12527	*See* PNL-SA–18980			
22	16:12525	*See* PNL-SA–18592			
23	16:12526	*See* PNL-SA–18628			
24	16:12563	*See* PNL-SA–18998			
25	16:13485	*See* PNL-SA–19014			
26	16:13752	*See* PNL-SA–18646			
27	16:12546	*See* WHC-SA–1000			
28	16:12550	*See* WSRC-MS–90-274			
29-Rev.1	16:12898	*See* WSRC-MS–90-280-Rev.1			
32	16:12548	*See* WHC-SA–1123			
34	16:12547	*See* WHC-SA–1120			
CONF-910276–		(Southwest Regional INGRES Users Association meeting; Albuquerque, NM (USA); 28 Feb - 1 mar 1991)			
4	16:13933	*See* SAND–91-0517C			
CONF-910278–		(2. international symposium on field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (USA); 12-14 Feb 1991)			
2	16:13158	*See* LA-UR–91-434			
3	16:13141	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008885	MF-701
CONF-910279–		(Environmentally conscious manufacturing/technology applications workshop; Albuquerque, NM (USA); 20 Feb 1991)			
6	16:13222	*See* SAND–91-0420C			

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7	16:13132	*See* SAND–91-0292C			
9	16:13353	*See* SAND–91-0327C			
10	16:12567	*See* SAND–91-0325C			
11	16:12535	*See* SAND–91-0324C			
12	16:13070	*See* SAND–91-0505C			
CONF-910285–		(American Nuclear Society (ANS) robotics for hostile environments; Albuquerque, NM (USA); 11 Feb 1991)			
1	16:13214	*See* PNL-SA–18821			
CONF-910287–		(National research and development conference on the control of hazardous materials; Anaheim, CA (USA); 20-22 Feb 1991)			
1	16:13569	*See* PNL-SA–18892			
2	16:13918	*See* PNL-SA–19026			
4	16:12562	*See* PNL-SA–18882			
CONF-910290–		(Pathway analysis and risk assessment for environmental compliance and dose reconstruction conference; Kiawah Island, SC (USA); 25 Feb - 1 mar 1991)			
1	16:12880	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008379	MF-402
CONF-910291–		(5. international conference on ultrastructure processing of ceramics, glasses, composites and advanced optical materials; Orlando, FL (USA); 17-21 Feb 1991)			
1	16:13138	*See* UCRL-JC–106520			
2	16:13135	*See* UCRL-JC–103740			
CONF-910293–		(HPCE '91: high performance capillary electrophoresis; San Diego, CA (USA); Feb 1991)			
1	16:13528	*See* LA-UR–91-510			
CONF-910294–		(Society of Photo-optical Instrumentation Engineers (SPIE) symposium on electronic imaging science and technology; San Jose, CA (USA); 25 Feb - 1 mar 1991)			
1	16:13306	*See* ANL/CP–71633			
CONF-910295–		(8. international conference on mathematical and computer modelling; College Park, MD (USA); 14 Feb 1991)			
1	16:13911	*See* LA-UR–91-729			
CONF-910306–		(International conference on energy in the 90's; Pittsburgh, PA (USA); 11-13 Mar 1991)			
1	16:12857	*See* LA-UR–91-133			
CONF-9103123–		(7. annual review of progress in applied computational electromagnetics; Monterey, CA (USA); 19-21 Mar 1991)			
2	16:13259	*See* UCRL-JC–105655			
3	16:13816	*See* UCRL-JC–106408			
CONF-9103131–		(Joint Army/Navy/NASA/Air Force (JANNAF) propulsion systems hazards subcommittee meeting; Albuquerque, NM (USA); 18-22 Mar 1991)			
1	16:13223	*See* SAND–91-0470C			
CONF-9103132–		(2. environmental radiation monitoring technology symposium; Taiwan (China); 11-14 Mar 1991)			
1	16:13749	*See* LA-UR–91-468			
CONF-9103134–		(Lunar and planetary science conference; Houston, TX (USA); 18-22 Mar 1991)			
1	16:13599	*See* LA-UR–91-618			
CONF-9103135–		(International Precious Metals Institute sampling and analysis seminar; New Orleans, LA (USA); 10-12 Mar 1991)			
1	16:13162	*See* UCRL-JC–106511			
CONF-9103136–		(5. national conference on undergraduate research; Pasadena, CA (USA); 21-23 Mar 1991)			
1	16:13455	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009132	MF-408
CONF-910328–		(NACE corrosion '91 symposium; Cincinnati, OH (USA); 11-15 Mar 1991)			
3	16:13033	*See* BNL–45651			

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CONF-910399–		(American Society for Nondestructive Testing spring conference; Oakland, CA (USA); 18-22 Mar 1991)			
2	16:13339	*See* UCRL-JC–105237			
CONF-9104106–		(53. annual meeting and exhibit of the American Power Conference; Chicago, IL (USA); 20 Apr - 1 may 1991)			
1	16:12780	*See* ANL/CP–71359			
CONF-9104109–		(4. international school for space simulation; Nara (Japan); 1-5 Apr 1991)			
2	16:13601	*See* UCRL-JC–106422			
CONF-910413–		(3. international conference on nuclear fuel reprocessing and waste management; Sendai (Japan); 15-18 Apr 1991)			
1	16:12784	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007759	MF-526
3	16:12785	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008378	MF-526
CONF-9104135–		(9. symposium on the training of nuclear facility personnel; Denver, CO (USA); 14-18 Apr 1991)			
1	16:13867	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008375	MF-900
CONF-910414–		(International topical meeting on advances in mathematics, computations and reactor physics; Pittsburgh, PA (USA); 28 Apr - 2 may 1991)			
6	16:12844	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007211	MF-542
23	16:12797	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008369	MF-405
25	16:13742	*See* SAND–90-2437C			
CONF-9104171–		(11. AIAA aerodynamic decelerator systems technology conference; San Diego, CA (USA); 9-11 Apr 1991)			
3	16:13218	*See* SAND–90-2158C			
5	16:13217	*See* SAND–90-2124C			
CONF-9104185–		(Combustion fundamentals and application conference; Nashville, TN (USA); 21-24 Apr 1991)			
1	16:13142	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007217	MF-112
CONF-9104189–		(IMACS symposium on iterative methods in linear algebra; Brussels (Belgium); 2-5 Apr 1991)			
1	16:13879	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007852	MF-405
CONF-9104190–		(HWHM/HMC-South '91: hazardous waste/hazardous materials conference; Houston, TX (USA); 24-26 Apr 1991)			
1	16:13863	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008366	MF-900
CONF-9104192–		(Workshop on laser ablation: mechanisms and application; Oak Ridge, TN (USA); 8-10 Apr 1991)			
1	16:13143	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008877	MF-401
CONF-9104194–		(1991 NASTRAN users colloquium; Williamsburg, VA (USA); 22-26 Apr 1991)			
1	16:13910	*See* LA-UR–91-678			
CONF-9104195–		(72. annual American Welding Society convention; Detroit, MI (USA); 14-19 Apr 1991)			
1	16:13211	*See* KCP–613-4380			
CONF-9104196–		(3. National Association of Regulatory Utility Commission (NARUC) conference on integrated resource planning; Sante Fe, NM (USA); 8-10 Apr 1991)			
1	16:12905	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009119	MF-222
CONF-9104197–		(Hazardous Materials Control Research Institute (HMCRI) superfund southeast conference; Houston, TX (USA); 24-26 Apr 1991)			
1	16:12879	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009155	MF-407
CONF-9104202–		(4. FIDAP users conference; Evanston, IL (USA); 14-16 Apr 1991)			
1	16:13616	*See* SAND–90-2656C			
CONF-910424–		(11. international conference on fluidized bed combustion; Montreal (Canada); 21-24 Apr 1991)			
3	16:12390	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008404	MF-103

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CONF-910426–		(Nuclear power plant and facility maintenance topical meeting; Salt Lake City, UT (USA); 7-11 Apr 1991)			
1	16:12819	*See* SAND–91-0187C			
CONF-910435–		(American Nuclear Society (ANS) international high level radioactive waste management conference; Las Vegas, NV (USA); 28 Apr - 3 may 1991)			
50	16:13338	*See* UCRL-JC–104768			
52	16:12537	*See* UCRL-JC–106161			
53	16:12781	*See* ANL/CP–71451			
54	16:12514	*See* LBL–30181			
55	16:12510	*See* LBL–29682			
CONF-910438–		(32. AIAA/ASME/ASCE/AHS/ASC structural dynamics and materials conference; Baltimore, MD (USA); 8-10 Apr 1991)			
1	16:13219	*See* SAND–90-2219C			
CONF-910468–		(1. annual international simulators conference; New Orleans, LA (USA); 1-5 Apr 1991)			
5	16:12825	*See* WSRC-MS–90-341			
CONF-910477–		(4. annual hazardous materials management central conference and exhibition; Rosemont, IL (USA); 3-5 Apr 1991)			
1	16:12881	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009123	
CONF-910503–		(International conference on nuclear data for science and technology; Juelich (Germany, F.R.); 13-17 May 1991)			
1	16:13725	*See* BNL–45200			
CONF-910505–		(Particle accelerator conference; San Francisco, CA (USA); 6-9 May 1991)			
1	16:13271	*See* FNAL/C–90/250			
CONF-9105103–		(International conference of the International Association for Computer Methods and Advances in Geomechanics; Cairns (Australia); 6-10 May 1991)			
1	16:12532	*See* SAND–90-2817C			
CONF-9105106–		(4. conference on the intersections between particle and nuclear physics; Tucson, AZ (USA); 23-29 May 1991)			
1	16:13261	*See* BNL–45839			
CONF-9105112–		(Working conference on constructing programs from specifications; Pacific Grove, CA (USA); 13-16 May 1991)			
1	16:13880	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006002	MF-405
CONF-9105122–		(1991 Institute of Electrical and Electronics Engineers (IEEE) international conference on acoustics, speech and signal processing; Toronto (Canada); 14-17 May 1991)			
1	16:13347	*See* UCRL-JC–105984			
CONF-9105123–		(13. international conference on software engineering; Austin, TX (USA); 13-16 May 1991)			
1	16:13925	*See* UCRL-JC–105017			
CONF-9105124–		(IFIP SEC '90; Brighton (UK); 15-17 May 1991)			
1	16:13927	*See* UCRL-JC–105962			
CONF-9105125–		(4. software engineeering standards application workshop; San Diego, CA (USA); 21-23 May 1991)			
1	16:13881	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007328	
CONF-9105126–		(DOE computer security group conference; Concord, CA (USA); 7-9 May 1991)			
1	16:13909	*See* LA-UR–91-334			
CONF-9105127–		(44. annual conference of the imaging science and technology; St. Paul, MN (USA); 12-17 May 1991)			
1	16:13131	*See* SAND–91-0232C			
CONF-9105129–		(7. international conference and exhibition on information security: creating confidence in information processing; Brighton (UK); 15-17 May 1991)			
1	16:13912	*See* LBL–30110			

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CONF-9105135–		(IEEE instrumentation/measurement technology conference; Atlanta, GA (USA); 14-16 May 1991)			
1	16:13921	*See* SAND–90-2550C			
CONF-9105136–		(5. national outdoor action conference of aquifer restoration; Las Vegas, NV (USA); 13-16 May 1991)			
1	16:13507	*See* FMPC–2218			
2	16:13478	*See* LA-UR–91-638			
CONF-9105137–		(2. international conference on supercritical fluids; Boston, MA (USA); 20-22 May 1991)			
1	16:13164	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009124	MF-401
CONF-910531–		(37. annual technical meeting and equipment exposition of the Institute of Environmental Sciences (IES); San Diego, CA (USA); 6-10 May 1991)			
1	16:13920	*See* SAND–90-2336C			
2	16:13236	*See* SAND–91-0400C			
3	16:13922	*See* SAND–91-0401C			
CONF-910544–		(4. International Association of Hydrological Sciences conference; Houston, TX (USA); May 1991)			
1	16:12399	*See* SAND–90-0191C			
CONF-910552–		(179. meeting of the Electrochemical Society; Washington, DC (USA); 5-10 May 1991)			
1	16:13067	*See* SAND–90-3143C			
2	16:13029	*See* BNL–45484			
3	16:13030	*See* BNL–45592			
4	16:13032	*See* BNL–45594			
5	16:13031	*See* BNL–45593			
6	16:13875	*See* BNL–45634			
7	16:13161	*See* SAND–90-3090C			
8	16:13069	*See* SAND–91-0011C			
CONF-910561–		(5. international conference on flow induced vibrations; Brighton (UK); 21-23 May 1991)			
1	16:13228	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006089	MF-406
CONF-910575–		(18. national conference on water resources planning and management; New Orleans, LA (USA); 20-22 May 1991)			
1	16:13418	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004542	MF-402
CONF-910577–		(2. international conference on transportation for the nuclear industry; Bournemouth (UK); 8-10 May 1991)			
1	16:13216	*See* SAND–90-1742C			
2	16:13193	*See* SAND–90-2250C			
CONF-910595–		(CLEO '91: conference on lasers and electro-optics; Baltimore, MD (USA); 12-17 May 1991)			
1	16:13251	*See* SAND–90-2998C			
2	16:13256	*See* UCRL-JC–105424			
3	16:13257	*See* UCRL-JC–105541			
4	16:13253	*See* SAND–91-0412C			
5	16:13243	*See* BNL–45415			
6	16:13307	*See* BNL–45416			
CONF-910596–		(IEEE symposium on research in security and privacy; Oakland, CA (USA); May 1991)			
1	16:13908	*See* LA-UR–90-3726			
2	16:13926	*See* UCRL-JC–105791			
CONF-910598–		(37. Instrument Society of America international instrumentation symposium; San Diego, CA (USA); 5-9 May 1991)			
1	16:13354	*See* UCRL-JC–105356			
2	16:13203	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007190	MF-400
COO– 1713-160	16:13186	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008170	MF-401
CRIE-W– 89052	16:13603	OSTI; NTIS (US Sales Only)		DE91759126	
DESY– 90-098	16:13644	OSTI; NTIS (US Sales Only); INIS		DE91756513	
90-099	16:13645	OSTI; NTIS (US Sales Only); INIS		DE91754943	
90-100	16:13315	OSTI; NTIS (US Sales Only); INIS		DE91754932	

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90-101	16:13646	OSTI; NTIS (US Sales Only); INIS		DE91754941	
90-104	16:13679	OSTI; NTIS (US Sales Only); INIS		DE91756511	
90-105	16:13680	OSTI; NTIS (US Sales Only); INIS		DE91754933	
90-106	16:13647	OSTI; NTIS (US Sales Only); INIS		DE91754942	
90-107	16:13648	OSTI; NTIS (US Sales Only); INIS		DE91756510	
90-108	16:13681	OSTI; NTIS (US Sales Only); INIS		DE91754934	
90-109	16:13342	OSTI; NTIS (US Sales Only); INIS		DE91756512	
DESY-F31–					
90-01	16:13627	OSTI; NTIS (US Sales Only); INIS		DE91756670	
DESY-M–					
90-13	16:13270	OSTI; NTIS (US Sales Only); INIS		DE91756671	
DOE/BP–					
1513	16:12596	*See* DOE/EA–0449			
DOE/CE–					
0281P-3	16:12896	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008200	MF-350
040762T-H1	16:12948	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008240	MF-310
DOE/CE/21003–					
T2	16:12923	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008529	MF-350
DOE/CE/27504–					
1	16:13009	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008035	MF-350
DOE/CH/10432–					
1	16:13419	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009140	MF-402
DOE/EA–					
0449	16:12596	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008895	MF-630
0474	16:13501	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008352	MF-902
0492	16:13420	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008894	MF-630
DOE/EH/79079–					
H1	16:12924	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005691	PC-350
DOE/EIA–					
0109(91/02)	16:12406	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91008858	MF-950
0130(91/02)	16:12421	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91008866	MF-950
0219(89)	16:12899	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE91008249	MF-950
0380(91/03)	16:12407	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009301	MF-950
0437(89)/2	16:12906	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91007885	MF-950
0520(91/02)	16:12408	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91008479	MF-950
0538(90/91-21)	16:12409	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009577	MF-950
0538(90/91-23)	16:12900	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91008845	MF-950
0538(90/91-25)	16:12410	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009631	MF-950
DOE/EIA-M–					
042(90)	16:12396	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91008037	MF-950
DOE/EM–					
0007T-Vol.1	16:13204	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008026	MF-900
0007T-Vol.2	16:13205	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008027	MF-900
0007T-Vol.3	16:13206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008028	MF-900
DOE/ER–					
0485P	16:13201	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008229	PC-402
0486T	16:13882	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008242	MF-405
0488P	16:13553	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009356	MF-407
DOE/ER/00038–					
3345	16:13184	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007969	MF-401
DOE/ER/01713–					
141	16:13187	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008145	MF-401
145	16:13188	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008169	MF-401
170	16:13189	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91006921	MF-401
DOE/ER/03069–					
1955	16:13316	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009049	MF-406
DOE/ER/12084–					
T1	16:13535	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008216	MF-408
DOE/ER/13252–					
5	16:13536	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008977	MF-408
DOE/ER/13327–					
T2	16:13144	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008146	MF-401
DOE/ER/13389–					
3	16:13112	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008276	MF-401
DOE/ER/13439–					
6	16:13196	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008282	MF-401
DOE/ER/13456–					
24	16:13604	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009518	MF-411
31	16:13605	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009517	MF-411
DOE/ER/13480–					
1	16:13145	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007457	MF-401

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DOE/ER/13507–6	16:13146	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008283	MF-401
DOE/ER/13518–5	16:13537	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008659	MF-408
DOE/ER/13580–1	16:13165	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008033	MF-401
DOE/ER/13591–5	16:13147	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009516	MF-401
DOE/ER/13597–T3	16:13612	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008042	MF-406
DOE/ER/13616–5	16:13166	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009672	MF-401
DOE/ER/13626–4	16:13167	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008284	MF-401
DOE/ER/13670–2	16:13593	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009813	MF-412
DOE/ER/13690–3	16:12582	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006730	MF-401
DOE/ER/13708–T2	16:13345	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009540	MF-406
DOE/ER/13736–T1	16:13522	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008231	MF-408
DOE/ER/13744–11	16:13168	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008512	MF-404
DOE/ER/13759–4	16:13040	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008228	MF-406
DOE/ER/13792–4	16:13148	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007980	MF-401
DOE/ER/13876–1	16:13169	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009136	MF-401
DOE/ER/13897–12	16:13764	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008285	MF-410
DOE/ER/13965–2	16:13197	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008548	MF-401
DOE/ER/13969–T1	16:13523	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008509	MF-408
DOE/ER/13971–7	16:13606	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009514	MF-411
DOE/ER/14037–T1	16:13538	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008972	MF-408
DOE/ER/14042–2	16:13207	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009374	MF-406
DOE/ER/14125–1	16:13344	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009153	MF-401
DOE/ER/18862–2	16:13826	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007763	MF-413; MF-712
DOE/ER/25061–9	16:13613	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009593	MF-405
DOE/ER/40200–222	16:13658	*See* DOE/ER/40224–152			
DOE/ER/40224–133	16:13618	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009589	MF-414
134	16:13283	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009588	MF-414
135	16:13317	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009587	MF-414
136	16:13649	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009526	MF-413
139	16:13650	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009585	MF-414
141	16:13651	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009584	MF-414
143	16:13652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009583	MF-414
144	16:13653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009582	MF-414
145	16:13674	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009581	MF-410
146	16:13654	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009580	MF-414
148	16:13675	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009579	MF-414
149	16:13655	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009578	MF-414
150	16:13656	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009575	MF-414
151	16:13657	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009574	MF-414
152	16:13658	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009573	MF-414
153	16:13659	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009572	MF-414
155	16:13660	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009571	MF-414
156	16:13661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009570	MF-414
157	16:13662	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009568	MF-414

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177	16:13318	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009564	MF-414
178	16:13319	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009488	MF-414; MF-406
179	16:13628	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009506	MF-414
183	16:13607	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009569	MF-414
184	16:13263	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009619	MF-406
DOE/ER/40235–					
T6	16:13619	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009543	MF-414
DOE/ER/40286–					
T3	16:13729	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008517	MF-413
DOE/ER/40318–					
T2	16:13320	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008003	MF-414
DOE/ER/40321–					
7	16:13689	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008909	MF-413
DOE/ER/40339–					
4	16:12572	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008508	MF-413
DOE/ER/40361–					
1	16:13690	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008434	MF-413
4	16:13691	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008553	MF-413
DOE/ER/40362–					
4	16:13697	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009048	MF-413
DOE/ER/40370–					
3	16:13730	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008993	MF-413
T3	16:13706	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009034	MF-413
DOE/ER/40423–					
12-P90	16:13663	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009609	MF-414
15	16:13664	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009614	MF-414
16-P90	16:13665	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009566	MF-414
17-P90	16:13666	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009615	MF-414
20	16:13667	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009586	MF-414
21	16:13668	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009590	MF-414
22	16:13669	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009611	MF-414
24	16:13670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009612	MF-414
DOE/ER/40457–					
T1	16:13629	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009541	MF-414
DOE/ER/40566–					
1	16:13692	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009137	MF-414
DOE/ER/45095–					
5	16:13041	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007880	MF-404
DOE/ER/45188–					
T1	16:13042	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008043	MF-404
DOE/ER/45194–					
6	16:13113	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009520	MF-401
DOE/ER/45252–					
T5	16:13114	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008841	MF-404
DOE/ER/45258–					
91-01	16:13115	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007973	MF-404
DOE/ER/45305–					
1	16:13092	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009047	MF-404
DOE/ER/45310–					
30	16:13043	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007932	MF-404
DOE/ER/45379–					
2	16:13026	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007883	MF-404
DOE/ER/45409–					
1	16:13116	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007977	MF-404
DOE/ER/45427–					
1-Pt.1	16:13093	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008266	MF-404
1-Pt.2	16:13094	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008267	MF-404
DOE/ER/52147–					
4	16:13827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008280	MF-421
DOE/ER/53269–					
3	16:13774	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009354	MF-427
DOE/ER/53276–					
3	16:13775	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009259	MF-420
DOE/ER/53302–					
3	16:13776	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009530	MF-420
DOE/ER/54088–					
1	16:13777	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009377	MF-420
DOE/ER/60325–					
T1	16:13554	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008206	MF-407

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DOE/ER/60348–T2	16:13587	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008286	MF-403
DOE/ER/60395–T2	16:13524	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008269	MF-408
DOE/ER/60460–10	16:13543	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009050	MF-408
DOE/ER/60555–4	16:13588	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009350	MF-403
DOE/ER/60556–T2	16:13548	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008839	MF-401
DOE/ER/60581–3	16:13456	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008515	MF-402
DOE/ER/60648–3	16:13170	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007876	MF-401
DOE/ER/60664–6	16:13457	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009044	MF-402
DOE/ER/60678–3	16:13555	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008838	MF-408
DOE/ER/60687–T1	16:13525	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008513	MF-408
DOE/ER/60721–3	16:13526	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009515	MF-413
DOE/ER/60784–2	16:13571	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008992	MF-408
DOE/ER/60972–1	16:13544	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008452	MF-408
DOE/ER/61014–1	16:13421	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008842	MF-402
DOE/ET/34212–57	16:12670	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91007935	MF-523
DOE/EV/70210–T2	16:13539	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008041	MF-408
DOE/FE–0212P	16:12644	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008624	PC-102; PC-105
0214P	16:12901	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007869	MF-126
0217P	16:12902	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008478	PC-101
0219P	16:12903	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008636	MF-101
DOE/ID–10289(90)	16:12845	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007908	PC-523
DOE/ID/12847–1	16:13044	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007163	PC-312
DOE/ID/12850–4	16:12614	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008524	MF-256
DOE/MA–0429P	16:13868	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008208	MF-900
DOE/MC/11076–2948	16:12355	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002026	MF-123
2949	16:12430	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002031	MF-123
2950	16:12428	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002030	MF-123
2951	16:12426	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002029	MF-123
DOE/MC/24266–2959	16:12303	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002039	MF-109
DOE/MC/25048–2962	16:13321	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008911	MF-103
DOE/NASA–0336-2	16:13017	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008223	MF-336
DOE/NE/34082–T10	16:12674	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008296	MF-523
T13	16:12675	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008299	MF-523
T14	16:12676	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008300	MF-523
T15	16:12677	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008301	MF-523
T18	16:12678	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008304	MF-523
T19	16:12679	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008305	MF-523
T21	16:12680	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008307	MF-523
T24	16:12681	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008310	MF-523
T25	16:12682	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008311	MF-523
T26	16:12683	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008312	MF-523
T28	16:12684	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008321	MF-523
T3	16:12671	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008289	MF-523
T30	16:12685	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008323	MF-523

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T31	16:12686	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008324	MF-523
T32	16:12687	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008325	MF-523
T34	16:12688	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008327	MF-523
T35	16:12689	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008328	MF-523
T41	16:12690	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008334	MF-523
T45	16:12691	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008338	MF-523
T46	16:12692	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008339	MF-523
T6	16:12672	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008292	MF-523
T7	16:12673	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008293	MF-523
DOE/NE/37968–					
T1	16:12846	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008837	MF-520
DOE/NV/10338–					
1	16:12397	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008521	MF-250
DOE/NV/10384–					
38	16:13502	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008907	MF-703
DOE/NV/10461–					
T42	16:12476	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008214	MF-814
DOE/NV/10845–					
4	16:13589	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008908	MF-800
DOE/ORO–					
914	16:12558	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008210	MF-502
914-App.C	16:12559	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008211	MF-502
914-App.D	16:12560	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008212	MF-502
DOE/PC/79680–					
T6	16:12911	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008519	MF-112
DOE/PC/79917–					
T6	16:12304	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007443	PC-108
DOE/PC/79922–					
T6	16:12356	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008440	MF-105
DOE/PC/79930–					
T5	16:12305	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008957	MF-109
DOE/PC/80509–					
T14	16:12306	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007434	PC-108
DOE/PC/88922–					
10	16:12322	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008354	MF-102
DOE/PC/88928–					
T2	16:12912	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008527	MF-112
DOE/PC/88929–					
T7	16:12307	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008535	MF-103
DOE/PC/88939–					
12	16:12323	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008353	MF-102
DOE/PC/88940–					
T8	16:12308	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008968	MF-108
DOE/PC/88945–					
T4	16:12645	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008248	MF-105
DOE/PC/89762–					
T3	16:12592	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008954	MF-113
DOE/PC/89775–					
3	16:12309	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008405	MF-102
DOE/PC/89776–					
T1	16:12391	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008432	MF-104
DOE/PC/89777–					
T2	16:12310	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008489	MF-109
DOE/PC/89781–					
5	16:12311	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008955	MF-102
DOE/PC/89865–					
T1	16:12312	*See* DOE/PC/90005–T33			
DOE/PC/89908–					
T5	16:12290	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008945	MF-102
DOE/PC/90005–					
T33	16:12312	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007397	MF-108
T35	16:12313	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008149	MF-108
DOE/PC/90044–					
1	16:12314	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008367	MF-109
DOE/PC/90096–					
1	16:12357	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008406	MF-105
DOE/PC/90169–					
T1	16:12392	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008486	MF-107
DOE/PC/90289–					
T1	16:12315	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008485	MF-108

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DOE/PC/90361–					
T1	16:12646	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008448	MF-105
DOE/PC/90512–					
2942	16:12316	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002041	PC-109
DOE/PC/90751–					
T6	16:12393	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008940	MF-104
T7	16:12394	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008941	MF-104
DOE/RL–					
91-01	16:12561	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009214	MF-702
91-04	16:13503	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009346	MF-703
DOE/RW–					
0268-Rev.1P	16:12477	OSTI (Free of Charge); INIS		TI91009181	MF-800
0299P	16:12478	INIS; OSTI (Free of Charge)		TI91008625	PC-800
DOE/SF/15927–					
T4	16:12925	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006763	MF-232
DOE/SF/18438–					
1	16:13828	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009378	MF-706
DOE/WIPP–					
89-015	16:12479	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008821	MF-721
89-025	16:12480	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008621	MF-721
91-014	16:12456	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008622	MF-721
DP–					
1778	16:12481	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009303	MF-721
DP-MS–					
87-2-Rev.1	16:13117	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009320	MF-701; MF-721
DPSPM-GEN–					
36	16:13928	OSTI; National Energy Software Center (software packages only), Argonne National Laboratory, 9800 South Cass Avenue, Argonne, IL 60439. Order documentation without complete package from NTIS; GPO Dep.	E 1.99:	DE91008549	MF-705
DPST–					
86-244	16:12831	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008126	MF-706
88-375	16:13504	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009306	MF-702
ECN-C–					
90-058	16:12630	OSTI; NTIS (US Sales Only)		DE91747340	
ED–					
111/64	16:12966	*See* GB–298			
125/159	16:12968	*See* GB–300			
191/217	16:12581	*See* GB–295			
221/310	16:12967	*See* GB–299			
230/343	16:12965	*See* GB–297			
253-236	16:12964	*See* GB–296			
262/218	16:12969	*See* GB–301			
89	16:12961	*See* GB–292			
94	16:12963	*See* GB–294			
EDR–					
14585	16:13017	*See* DOE/NASA–0336-2			
EEO-ED–					
122/53	16:12980	*See* GB–318			
143/47	16:12982	*See* GB–320			
188/82	16:12589	*See* GB–315			
232/261	16:12997	*See* GB–340			
245/208	16:12979	*See* GB–317			
260/341	16:12981	*See* GB–319			
263/287	16:12995	*See* GB–337			
266/306	16:12996	*See* GB–339			
282/271	16:13001	*See* GB–344			
286/335	16:13021	*See* GB–322			
84/155	16:12590	*See* GB–321			
EEO-NP–					
3	16:12958	*See* GB–287			
4	16:12957	*See* GB–286			
5	16:12956	*See* GB–285			
7	16:12954	*See* GB–283			
14	16:12953	*See* GB–282			
16	16:12583	*See* GB–288			
17	16:12955	*See* GB–284			
19	16:12959	*See* GB–289			

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EEO-RD–					
5	16:12989	*See* GB–330			
7	16:12988	*See* GB–329			
8	16:12990	*See* GB–331			
15	16:12986	*See* GB–327			
16/17	16:12991	*See* GB–332			
17/16	16:12985	*See* GB–326			
18/25	16:12983	*See* GB–324			
19/26	16:12999	*See* GB–342			
30/31	16:12998	*See* GB–341			
33/35	16:12987	*See* GB–328			
34/37	16:12994	*See* GB–335			
37	16:12992	*See* GB–333			
38/40	16:12984	*See* GB–325			
39/41	16:12993	*See* GB–334			
4/9	16:13000	*See* GB–343			
EFI-TR–					
3677	16:12595	OSTI; NTIS (US Sales Only)		DE91753004	
3678	16:12907	OSTI; NTIS (US Sales Only)		DE91753013	
EGG–					
10617-1062	16:13458	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008633	MF-702
2634	16:12866	*See* NUREG/CR–5667			
2635-Vol.1	16:12521	*See* NUREG/CR–5672-Vol.1			
EML–					
532	16:13422	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008425	MF-402
535	16:13423	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008422	MF-402
ENDF–					
350	16:13695	*See* ORNL/TM–11763			
ENEA-RT-AMB–					
90-05	16:13459	OSTI; NTIS (US Sales Only); INIS		DE91752930	
90-09	16:13556	OSTI; NTIS (US Sales Only); INIS		DE91752931	
90-13	16:12647	OSTI; NTIS (US Sales Only); INIS		DE91752934	
90-14	16:13149	OSTI; NTIS (US Sales Only); INIS		DE91752932	
90-19	16:13505	OSTI; NTIS (US Sales Only); INIS		DE91752933	
ENEA-RT-DISP–					
90-01	16:13424	OSTI; NTIS (US Sales Only); INIS		DE91752925	
ENEA-RT-ENERG–					
90-02	16:13118	OSTI; NTIS (US Sales Only); INIS		DE91752918	
ENEA-RT-FUS–					
89-14	16:13778	OSTI; NTIS (US Sales Only); INIS		DE91752905	
89-15	16:13779	OSTI; NTIS (US Sales Only); INIS		DE91752923	
89-26	16:13780	OSTI; NTIS (US Sales Only); INIS		DE91752900	
89-27	16:13781	OSTI; NTIS (US Sales Only); INIS		DE91752903	
ENEA-RT-INN–					
90-01	16:13614	OSTI; NTIS (US Sales Only); INIS		DE91752921	
90-08	16:13045	OSTI; NTIS (US Sales Only); INIS		DE91752920	
90-10	16:13150	OSTI; NTIS (US Sales Only); INIS		DE91752914	
90-11	16:13046	OSTI; NTIS (US Sales Only); INIS		DE91752915	
90-13	16:12885	OSTI; NTIS (US Sales Only); INIS		DE91752919	
ENEA-RT-TIB–					
89-68	16:13119	OSTI; NTIS (US Sales Only); INIS		DE91752935	
89-70	16:13120	OSTI; NTIS (US Sales Only); INIS		DE91752922	
89-71	16:13245	OSTI; NTIS (US Sales Only)		DE91752881	
89-74	16:13246	OSTI; NTIS (US Sales Only); INIS		DE91752916	
89-75	16:13121	OSTI; NTIS (US Sales Only); INIS		DE91752924	
89-78	16:13095	OSTI; NTIS (US Sales Only); INIS		DE91752917	
ENEA-RTI-STUDI-STRAT–					
90-10	16:12908	OSTI; NTIS (US Sales Only)		DE91752882	
ENET–					
8700316/1	16:12411	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749223	
8900004/1	16:12926	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749225	
8900013/1	16:12894	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749224	
8900025-1	16:12607	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749219	
8900025/2	16:12609	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749220	
8900028/1	16:12612	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749214	

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ENET–					
8900052/1	16:12575	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749215	
8900123	16:12615	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749221	
8900129/1	16:12916	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749216	
8900335/1	16:12598	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749222	
8900417/1	16:12613	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749218	
8900420-1	16:12874	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749217	
8900475/1	16:12798	OSTI; NTIS (US Sales Only); INIS		DE91623398	
8900645/1	16:12927	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749210	
8900645/2	16:12928	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749211	
8900645/3	16:12929	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749212	
8900650/1	16:12579	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91749213	
EPA–					
520/5-90-032	16:13322	OSTI; US-EPA, Office of Radiation Programs, NAREL, 1504 Avenue A, Montgomery, AL 36115-2601		TI91008155	
ESG–					
100	16:13274	*See* LBL–29233			
112	16:13267	*See* LBL–29957			
99	16:13266	*See* LBL–29232			
ETDE-IT–					
90-91	16:12949	OSTI; NTIS (US Sales Only)		DE91744333	
91-05	16:13151	OSTI; NTIS (US Sales Only); INIS		DE91752898	
91-06	16:13883	OSTI; NTIS (US Sales Only); INIS		DE91752899	
91-07	16:13782	OSTI; NTIS (US Sales Only); INIS		DE91752901	
91-08	16:13829	OSTI; NTIS (US Sales Only); INIS		DE91752904	
91-09	16:13247	OSTI; NTIS (US Sales Only)		DE91752866	
91-10	16:12635	OSTI; NTIS (US Sales Only); INIS		DE91752912	
91-11	16:12636	OSTI; NTIS (US Sales Only); INIS		DE91752913	
91-12	16:13830	OSTI; NTIS (US Sales Only); INIS		DE91752902	
91-13	16:13765	OSTI; NTIS (US Sales Only); INIS		DE91752926	
91-14	16:13831	OSTI; NTIS (US Sales Only); INIS		DE91752927	
91-15	16:12913	OSTI; NTIS (US Sales Only); INIS		DE91752928	
91-16	16:13783	OSTI; NTIS (US Sales Only); INIS		DE91752929	
91-17	16:12803	OSTI; NTIS (US Sales Only); INIS		DE91752937	
ETDE-mf–					
1754626	16:12610	OSTI; NTIS (US Sales Only)		DE91754626	
1754644	16:13208	OSTI; NTIS (US Sales Only)		DE91754644	
1754766	16:13572	OSTI; NTIS (US Sales Only)		DE91754766	
1754768	16:13573	OSTI; NTIS (US Sales Only)		DE91754768	
1754792	16:13209	OSTI; NTIS (US Sales Only)		DE91754792	
1754846	16:12950	OSTI; NTIS (US Sales Only)		DE91754846	
1754912	16:13506	OSTI; NTIS (US Sales Only)		DE91754912	
1754952	16:12395	OSTI; NTIS (US Sales Only)		DE91754952	
1755026	16:12882	OSTI; NTIS (US Sales Only)		DE91755026	
1756176	16:12403	OSTI; NTIS (US Sales Only)		DE91756176	
1756208	16:12637	OSTI; NTIS (US Sales Only)		DE91756208	
1756252	16:13425	OSTI; NTIS (US Sales Only)		DE91756252	
1756254	16:12577	OSTI; NTIS (US Sales Only)		DE91756254	
1756440	16:13426	OSTI; NTIS (US Sales Only)		DE91756440	
1756454	16:12904	OSTI; NTIS (US Sales Only)		DE91756454	
1756465	16:13096	OSTI; NTIS (US Sales Only)		DE91756465	
1756508	16:13171	OSTI; NTIS (US Sales Only)		DE91756508	
1756514	16:12360	OSTI; NTIS (US Sales Only)		DE91756514	
1756520	16:12361	OSTI; NTIS (US Sales Only)		DE91756520	
1756887	16:13018	OSTI; NTIS (US Sales Only)		DE91756887	
1759224	16:12930	OSTI; NTIS (US Sales Only)		DE91759224	
1759398	16:12362	OSTI; NTIS (US Sales Only)		DE91759398	
1759403	16:13010	OSTI; NTIS (US Sales Only)		DE91759403	
1759408	16:12601	OSTI; NTIS (US Sales Only)		DE91759408	
1759414	16:12423	OSTI; NTIS (US Sales Only)		DE91759414	
1759415	16:12648	OSTI; NTIS (US Sales Only)		DE91759415	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1759416	16:12274	OSTI; NTIS (US Sales Only)		DE91759416	
1759417	16:13198	OSTI; NTIS (US Sales Only)		DE91759417	
1759511	16:13011	OSTI; NTIS (US Sales Only)		DE91759511	
ETDE/JP-mf–					
1759127	16:12273	OSTI; NTIS (US Sales Only)		DE91759127	
ETDE/NL-mf–					
1747307	16:12944	OSTI; NTIS (US Sales Only)		DE91747307	
1747374	16:12604	OSTI; NTIS (US Sales Only)		DE91747374	
ETSU-B–					
1238	16:12951	OSTI; NTIS (US Sales Only)		DE91750295	
ETU–					
U-9018	16:12585	*See* SVF–387			
U7007	16:12359	*See* SVF–371			
ETY–					
26/1990	16:12317	OSTI; NTIS (US Sales Only)		DE91753000	
EUR–					
12359	16:12602	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 12.50		TI91008696	
12615	16:13869	OSTI; NTIS (US Sales Only)		TI91757069	
12672	16:12482	OSTI; NTIS (US Sales Only)		TI91757028	
12675	16:12466	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 10		TI91008701	
12694	16:12931	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009232	
12695	16:12952	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91008698	
12699	16:12605	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91008699	
12704	16:12483	OSTI; NTIS (US Sales Only)		TI91752687	
12708	16:12875	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91008700	
12718	16:12578	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91008702	
12727	16:12832	OSTI; NTIS (US Sales Only)		TI91752662	
12736	16:12580	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 20		TI91008697	
12763	16:12484	OSTI; NTIS (US Sales Only)		TI91757060	
12768	16:12457	OSTI; NTIS (US Sales Only)		TI91757062	
12781	16:12693	OSTI; NTIS (US Sales Only)		TI91757095	
12782	16:12694	OSTI; NTIS (US Sales Only)		TI91757096	
12795	16:13210	OSTI; NTIS (US Sales Only)		TI91757067	
12796	16:12485	OSTI; NTIS (US Sales Only)		TI91752685	
12802	16:12932	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009243	
12815	16:12486	OSTI; NTIS (US Sales Only)		TI91757066	
12819	16:12804	OSTI; NTIS (US Sales Only)		TI91757099	
12822	16:13870	OSTI; NTIS (US Sales Only)		TI91757070	
12840	16:12487	OSTI; NTIS (US Sales Only)		TI91752684	
12845	16:13047	OSTI; NTIS (US Sales Only)		TI91757097	
12874	16:12488	OSTI; NTIS (US Sales Only)		TI91757065	
12875	16:12805	OSTI; NTIS (US Sales Only)		TI91757093	
12883	16:12695	OSTI; NTIS (US Sales Only)		TI91757081	
12884	16:12847	OSTI; NTIS (US Sales Only)		TI91752686	
12888	16:13048	OSTI; NTIS (US Sales Only)		TI91757068	
12911	16:12489	OSTI; NTIS (US Sales Only)		TI91757059	
12912	16:12490	OSTI; NTIS (US Sales Only)		TI91757061	
12935	16:12491	OSTI; NTIS (US Sales Only)		TI91757029	
12947	16:12806	OSTI; NTIS (US Sales Only)		TI91757092	
12991	16:12786	OSTI; NTIS (US Sales Only)		TI91757080	

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13008	16:12492	OSTI; NTIS (US Sales Only)		TI91757064	
13018	16:12493	OSTI; NTIS (US Sales Only)		TI91757058	
13021	16:12787	OSTI; NTIS (US Sales Only)		TI91757094	
13027	16:12494	OSTI; NTIS (US Sales Only)		TI91757057	
13053	16:12495	OSTI; NTIS (US Sales Only)		TI91757063	
13056	16:12807	OSTI; NTIS (US Sales Only)		TI91757098	
FASAC-TAR–					
91007476	16:13248	OSTI; Science Applications International Corporation, 1710 Goodridge Drive, P.O. Box 1303, McLean, VA 22102		TI91007476	
91007477	16:13249	OSTI; Science Applications International Corp., 1710 Goodridge Drive, P.O. Box 1303, McLean, VA 22102		TI91007477	
91008348	16:13356	OSTI; Science Applications International Corporation, 1710 Goodridge Dr., P.O. Box 1303, McLean, VA 22102		TI91008348	
FAW-TR–					
90010	16:13417	OSTI; NTIS (US Sales Only)		DE91756456	
90027	16:13884	OSTI; NTIS (US Sales Only)		DE91754842	
FMPC–					
2218	16:13507	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008893	MF-702
FMPC/Sub–					
29	16:13427	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008415	MF-702
FNAL-TM–					
1708	16:13287	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009359	PC-406
1716	16:13273	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009358	PC-405
1719	16:13288	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009357	PC-406
FNAL/C–					
90/250	16:13271	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91006379	MF-414
90/271-E	16:13630	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008616	MF-414
91/25-E	16:13631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009462	MF-414
91/26-E	16:13632	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009463	MF-414
91/38	16:13284	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009461	MF-414
91/39	16:13272	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009457	MF-414
91/44	16:13285	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009456	MF-414
91/47	16:13286	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009454	MF-414
91/51-A	16:13594	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009459	MF-412
91/53-A	16:13595	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009458	MF-412
91/61-A	16:13596	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009669	MF-412
FRCEA-TH–					
314	16:12451	OSTI; NTIS (US Sales Only)		DE91752725	
314-Ann	16:12452	OSTI; NTIS (US Sales Only)		DE91752724	
322	16:12576	OSTI; NTIS (US Sales Only)		DE91753120	
327	16:12496	OSTI; NTIS (US Sales Only)		DE91752689	
FRNC-TH–					
3698	16:13172	OSTI; NTIS (US Sales Only)		DE91752682	
FhG-IWM-W–					
10/90	16:13097	OSTI; NTIS (US Sales Only)		DE91759376	
G–					
58/85	16:12960	*See* GB–291			
GA-A–					
20272	16:13784	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008925	MF-427
20277	16:13785	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008924	MF-427
20280	16:13832	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008923	MF-421
20281	16:13786	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008922	MF-421
20283	16:13787	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008921	MF-421
20299	16:13833	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008499	MF-421
20317	16:13834	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008920	MF-421
20330	16:13835	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008498	MF-420
20335	16:12820	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008630	MF-224
20371	16:13836	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008408	MF-420
GANIL-A–					
9004	16:13289	OSTI; NTIS (US Sales Only)		DE91757078	
9005	16:13290	OSTI; NTIS (US Sales Only)		DE91757077	
9007	16:13264	OSTI; NTIS (US Sales Only)		DE91757076	
GANIL-P–					
8902	16:13707	OSTI; NTIS (US Sales Only)		DE91752690	
9013	16:13708	OSTI; NTIS (US Sales Only)		DE91752698	
9016	16:13713	OSTI; NTIS (US Sales Only)		DE91752743	
9018	16:13714	OSTI; NTIS (US Sales Only)		DE91757088	
9020	16:13885	OSTI; NTIS (US Sales Only)		DE91752697	

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GANIL-T–					
9001	16:13715	OSTI; NTIS (US Sales Only)		DE91757083	
GB–					
282	16:12953	OSTI; NTIS (US Sales Only)		DE91752819	
283	16:12954	OSTI; NTIS (US Sales Only)		DE91752820	
284	16:12955	OSTI; NTIS (US Sales Only)		DE91756933	
285	16:12956	OSTI; NTIS (US Sales Only)		DE91756934	
286	16:12957	OSTI; NTIS (US Sales Only)		DE91752821	
287	16:12958	OSTI; NTIS (US Sales Only)		DE91756935	
288	16:12583	OSTI; NTIS (US Sales Only)		DE91756936	
289	16:12959	OSTI; NTIS (US Sales Only)		DE91756937	
290	16:12933	OSTI; NTIS (US Sales Only)		DE91752777	
291	16:12960	OSTI; NTIS (US Sales Only)		DE91752778	
292	16:12961	OSTI; NTIS (US Sales Only)		DE91750263	
293	16:12962	OSTI; NTIS (US Sales Only)		DE91750264	
294	16:12963	OSTI; NTIS (US Sales Only)		DE91750265	
295	16:12581	OSTI; NTIS (US Sales Only)		DE91750266	
296	16:12964	OSTI; NTIS (US Sales Only)		DE91750267	
297	16:12965	OSTI; NTIS (US Sales Only)		DE91752779	
298	16:12966	OSTI; NTIS (US Sales Only)		DE91750268	
299	16:12967	OSTI; NTIS (US Sales Only)		DE91750269	
300	16:12968	OSTI; NTIS (US Sales Only)		DE91750270	
301	16:12969	OSTI; NTIS (US Sales Only)		DE91750271	
303	16:12970	OSTI; NTIS (US Sales Only)		DE91750296	
304	16:12971	OSTI; NTIS (US Sales Only)		DE91752780	
305	16:12972	OSTI; NTIS (US Sales Only)		DE91752781	
306	16:12973	OSTI; NTIS (US Sales Only)		DE91752782	
307	16:12934	OSTI; NTIS (US Sales Only)		DE91752783	
308	16:12974	OSTI; NTIS (US Sales Only)		DE91752784	
309	16:12975	OSTI; NTIS (US Sales Only)		DE91752785	
310	16:12976	OSTI; NTIS (US Sales Only)		DE91752786	
311	16:12977	OSTI; NTIS (US Sales Only)		DE91752787	
312	16:12978	OSTI; NTIS (US Sales Only)		DE91752788	
313	16:12935	OSTI; NTIS (US Sales Only)		DE91752789	
314	16:12936	OSTI; NTIS (US Sales Only)		DE91752790	
315	16:12589	OSTI; NTIS (US Sales Only)		DE91752799	
317	16:12979	OSTI; NTIS (US Sales Only)		DE91752794	
318	16:12980	OSTI; NTIS (US Sales Only)		DE91752793	
319	16:12981	OSTI; NTIS (US Sales Only)		DE91752791	
320	16:12982	OSTI; NTIS (US Sales Only)		DE91752796	
321	16:12590	OSTI; NTIS (US Sales Only)		DE91752797	
322	16:13021	OSTI; NTIS (US Sales Only)		DE91752802	
324	16:12983	OSTI; NTIS (US Sales Only)		DE91752804	
325	16:12984	OSTI; NTIS (US Sales Only)		DE91752805	
326	16:12985	OSTI; NTIS (US Sales Only)		DE91752806	
327	16:12986	OSTI; NTIS (US Sales Only)		DE91752807	
328	16:12987	OSTI; NTIS (US Sales Only)		DE91752808	
329	16:12988	OSTI; NTIS (US Sales Only)		DE91752812	
330	16:12989	OSTI; NTIS (US Sales Only)		DE91752813	
331	16:12990	OSTI; NTIS (US Sales Only)		DE91752814	
332	16:12991	OSTI; NTIS (US Sales Only)		DE91752815	
333	16:12992	OSTI; NTIS (US Sales Only)		DE91752816	
334	16:12993	OSTI; NTIS (US Sales Only)		DE91752817	
335	16:12994	OSTI; NTIS (US Sales Only)		DE91752818	
337	16:12995	OSTI; NTIS (US Sales Only)		DE91752801	
339	16:12996	OSTI; NTIS (US Sales Only)		DE91752795	
340	16:12997	OSTI; NTIS (US Sales Only)		DE91752792	
341	16:12998	OSTI; NTIS (US Sales Only)		DE91752809	
342	16:12999	OSTI; NTIS (US Sales Only)		DE91752810	
343	16:13000	OSTI; NTIS (US Sales Only)		DE91752811	
344	16:13001	OSTI; NTIS (US Sales Only)		DE91752800	
GEFR–					
00482	16:12497	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007426	PC-535
GKSS–					
90/E/18	16:13152	OSTI; NTIS (US Sales Only); INIS		DE91754878	
90/E/24	16:13428	OSTI; NTIS (US Sales Only)		DE91754890	
90/E/31	16:13049	OSTI; NTIS (US Sales Only); INIS		DE91756679	
90/E/36	16:13429	OSTI; NTIS (US Sales Only)		DE91759513	
90/E/37	16:13348	OSTI; NTIS (US Sales Only)		DE91759521	
GRS-F–					
182	16:12848	OSTI; NTIS (US Sales Only); INIS		DE91759431	

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GSF–					
15/90	16:12498	OSTI; NTIS (US Sales Only); INIS		DE91756241	
21/90	16:13930	OSTI; NTIS (US Sales Only)		DE91759351	
24/90	16:12499	OSTI; NTIS (US Sales Only); INIS		DE91756221	
27/90	16:12500	OSTI; NTIS (US Sales Only); INIS		DE91759438	
30/90	16:12849	OSTI; NTIS (US Sales Only); INIS		DE91759407	
34/90	16:12453	OSTI; NTIS (US Sales Only); INIS		DE91759429	
5/90	16:13929	OSTI; NTIS (US Sales Only)		DE91756678	
GSF-HY–					
1.90	16:13508	OSTI; NTIS (US Sales Only); INIS		DE91759510	
GSF-TL–					
18/90	16:12499	*See* GSF–24/90			
28/90	16:12500	*See* GSF–27/90			
8/90	16:12498	*See* GSF–15/90			
GSI–					
90-24	16:13766	OSTI; NTIS (US Sales Only); INIS		DE91754794	
90-27	16:13701	OSTI; NTIS (US Sales Only); INIS		DE91756210	
90-67(prepr.)	16:13731	OSTI; NTIS (US Sales Only); INIS		DE91756665	
90-68(prepr.)	16:13597	OSTI; NTIS (US Sales Only); INIS		DE91756666	
90-70(prepr.)	16:13759	OSTI; NTIS (US Sales Only); INIS		DE91756668	
GUPTA–					
90/5-1	16:13681	*See* DESY–90-108			
HLRZ–					
90-042	16:13681	*See* DESY–90-108			
HUTP–					
90/A047	16:13646	*See* DESY–90-101			
HW–					
57289	16:12501	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009406	MF-721
59408	16:12445	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008545	MF-501
66767	16:12835	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009424	MF-520
67185	16:12836	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009423	MF-504
72001	16:12850	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009401	MF-520
72405	16:12851	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009403	MF-520
73285	16:12502	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009595	MF-721
HW-SA–					
2277	16:13574	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008868	MF-607
IAEA-CN–					
53/A-1-2	16:13823	*See* CONF-901025–37			
53/A-3-1	16:13787	*See* GA-A–20283			
53/A-3-4	16:13822	*See* CONF-901025–34			
53/A-4-1	16:13771	*See* CONF-901025–33			
53/A-5-3	16:13821	*See* CONF-901025–32			
53/A-6-3	16:13773	*See* CONF-901025–36			
53/E-1-2	16:13786	*See* GA-A–20281			
53/E-2-1-1	16:13772	*See* CONF-901025–35			
53/G-1-3	16:13832	*See* GA-A–20280			
IAERU–					
9002	16:13190	OSTI; NTIS (US Sales Only); INIS		DE91755687	
IC–					
89/205	16:13767	OSTI; NTIS (US Sales Only); INIS		DE91621723	
90/271	16:13643	*See* CONF-9006275–3			
IFP–					
38-467	16:12422	OSTI; NTIS (US Sales Only)		DE91757843	
38124	16:13019	OSTI; NTIS (US Sales Only)		DE91753119	
38184	16:12416	OSTI; NTIS (US Sales Only)		DE91753106	
38390	16:12398	OSTI; NTIS (US Sales Only)		DE91757842	
38493	16:12400	OSTI; NTIS (US Sales Only)		DE91757841	
IKU-R–					
34.2847.00/01/90	16:13472	OSTI; NTIS (US Sales Only)		DE91753014	
34.2847.00/02/90	16:12413	OSTI; NTIS (US Sales Only)		DE91753015	
34.2847.00/03/90	16:12638	OSTI; NTIS (US Sales Only)		DE91753016	
INDC(CCP)–					
322/L	16:13740	OSTI; NTIS (US Sales Only); INIS		DE91623087	
INDC(NDS)–					
241/LF	16:13838	OSTI; NTIS (US Sales Only); INIS		DE91623022	
INFN/AE–					
90/14	16:13682	OSTI; NTIS (US Sales Only); Istituto Nazionale di Fisica Nucleare, Via Celoria 16, 20133 Milano, Italy		DE91008961	
INIS-BR–					
2387	16:13744	OSTI; NTIS (US Sales Only); INIS		DE91622618	

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2388	16:13545	OSTI; NTIS (US Sales Only); INIS		DE91622669	
INIS-CL–					
003	16:13745	OSTI; NTIS (US Sales Only); INIS		DE91622619	
INIS-GB–					
302	16:12827	OSTI; NTIS (US Sales Only); INIS		DE91623440	
INIS-XN–					
286	16:13581	OSTI; NTIS (US Sales Only); INIS		DE91621707	
287	16:12568	OSTI; NTIS (US Sales Only); INIS		DE91621708	
305	16:13693	OSTI; NTIS (US Sales Only)		DE91752641	
307	16:12468	OSTI; NTIS (US Sales Only); INIS		DE91623469	
INIS-mf–					
12171	16:12795	OSTI; NTIS (US Sales Only); INIS		DE91756207	
12176	16:12889	OSTI; NTIS (US Sales Only); INIS		DE91756443	
12178	16:13557	OSTI; NTIS (US Sales Only); INIS		DE91754767	
12179	16:13541	OSTI; NTIS (US Sales Only); INIS		DE91754769	
12180	16:13558	OSTI; NTIS (US Sales Only); INIS		DE91754770	
12185	16:13580	OSTI; NTIS (US Sales Only); INIS		DE91759396	
12781	16:12697	OSTI; NTIS (US Sales Only); INIS		DE91622762	
12784	16:12655	OSTI; NTIS (US Sales Only); INIS		DE91003072	
12791	16:13671	OSTI; NTIS (US Sales Only); INIS		DE91622150	
12794	16:13672	OSTI; NTIS (US Sales Only); INIS		DE91623062	
12796	16:12725	OSTI; NTIS (US Sales Only); INIS		DE91623406	
IPP–					
1/256	16:13791	OSTI; NTIS (US Sales Only); INIS		DE91754662	
2/310	16:13840	OSTI; NTIS (US Sales Only); INIS		DE91754671	
4/243	16:13792	OSTI; NTIS (US Sales Only); INIS		DE91754665	
4/244	16:13793	OSTI; NTIS (US Sales Only); INIS		DE91754669	
6/294	16:13794	OSTI; NTIS (US Sales Only); INIS		DE91754666	
6/295	16:13795	OSTI; NTIS (US Sales Only); INIS		DE91754661	
6/296	16:13796	OSTI; NTIS (US Sales Only); INIS		DE91754672	
I/255	16:13797	OSTI; NTIS (US Sales Only); INIS		DE91754667	
III/159	16:13798	OSTI; NTIS (US Sales Only); INIS		DE91754668	
III/167	16:13841	OSTI; NTIS (US Sales Only); INIS		DE91754670	
IS-T–					
1449	16:13154	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008926	MF-402
1493	16:13173	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007525	MF-401
1498	16:13174	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006695	MF-401
1508	16:13175	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007524	MF-401
ITP-SB–					
90-68	16:13663	*See* DOE/ER/40423–12-P90			
IVO-A–					
01/90	16:13579	OSTI; NTIS (US Sales Only)		DE91752996	
IVO-B–					
03/90	16:12654	OSTI; NTIS (US Sales Only)		DE91752995	
JAERI-M–					
90-182	16:12790	OSTI; NTIS (US Sales Only); INIS		DE91755673	
90-189	16:12837	OSTI; NTIS (US Sales Only); INIS		DE91755669	
90-190	16:12838	OSTI; NTIS (US Sales Only); INIS		DE91755881	
90-193	16:12659	OSTI; NTIS (US Sales Only); INIS		DE91755640	
90-194	16:12574	OSTI; NTIS (US Sales Only); INIS		DE91755676	
90-197	16:13723	OSTI; NTIS (US Sales Only); INIS		DE91755670	
90-198	16:13694	OSTI; NTIS (US Sales Only); INIS		DE91755675	
90-199	16:13906	OSTI; NTIS (US Sales Only); INIS		DE91755641	
90-200	16:13799	OSTI; NTIS (US Sales Only); INIS		DE91755671	
JPL-D–					
7824	16:13020	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007689	MF-333
8051	16:13199	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007923	MF-310
Juel–					
2357	16:12890	OSTI; NTIS (US Sales Only); INIS		DE91759221	
2371	16:13842	OSTI; NTIS (US Sales Only); INIS		DE91754660	
2372	16:13002	OSTI; NTIS (US Sales Only)		DE91756439	
2374	16:13122	OSTI; NTIS (US Sales Only)		DE91754836	
2375	16:13052	OSTI; NTIS (US Sales Only); INIS		DE91756466	
2377	16:13053	OSTI; NTIS (US Sales Only); INIS		DE91754840	
2378	16:13843	OSTI; NTIS (US Sales Only); INIS		DE91754664	
2379	16:13054	OSTI; NTIS (US Sales Only); INIS		DE91754841	
2381	16:13055	OSTI; NTIS (US Sales Only); INIS		DE91754835	
2384	16:13229	OSTI; NTIS (US Sales Only); INIS		DE91759216	
2390	16:12883	OSTI; NTIS (US Sales Only)		DE91759457	
2396	16:13737	OSTI; NTIS (US Sales Only); INIS		DE91756673	

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Juel-Spez–					
536	16:13559	OSTI; NTIS (US Sales Only); INIS		DE91759217	
547	16:13509	OSTI; NTIS (US Sales Only); INIS		DE91759218	
548	16:13323	OSTI; NTIS (US Sales Only); INIS		DE91756240	
580	16:12593	OSTI; NTIS (US Sales Only)		DE91754695	
K/ITP–					
362	16:12660	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007984	
KC-PUB–					
89-01-E	16:13056	OSTI; NTIS (US Sales Only)		DE91752953	
KCP–					
613-4380	16:13211	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008988	MF-706
KECL–					
87-175	16:12425	*See* CONF-871198–			
KFA-ASS–					
0431	16:13748	OSTI; NTIS (US Sales Only); INIS		DE91754793	
KFK–					
3701-e	16:12855	OSTI; NTIS (US Sales Only); INIS		DE91759268	
4358	16:12856	OSTI; NTIS (US Sales Only); INIS		DE91759266	
4713	16:13560	OSTI; NTIS (US Sales Only); INIS		DE91759440	
4732	16:13864	OSTI; NTIS (US Sales Only); INIS		DE91759517	
4734	16:13057	OSTI; NTIS (US Sales Only); INIS		DE91759518	
4762	16:13324	OSTI; NTIS (US Sales Only); INIS		DE91759265	
4767	16:13058	OSTI; NTIS (US Sales Only); INIS		DE91754837	
4775	16:13155	OSTI; NTIS (US Sales Only); INIS		DE91759270	
4779	16:12800	OSTI; NTIS (US Sales Only); INIS		DE91759549	
4784	16:13325	OSTI; NTIS (US Sales Only); INIS		DE91759264	
4785	16:13844	OSTI; NTIS (US Sales Only); INIS		DE91759269	
4787	16:13212	OSTI; NTIS (US Sales Only); INIS		DE91759273	
4791	16:13098	OSTI; NTIS (US Sales Only); INIS		DE91754838	
4796	16:13235	OSTI; NTIS (US Sales Only); INIS		DE91754839	
4800	16:12508	OSTI; NTIS (US Sales Only); INIS		DE91759550	
4809	16:13845	OSTI; NTIS (US Sales Only); INIS		DE91759458	
KFK-PEF–					
65	16:13575	OSTI; NTIS (US Sales Only)		DE91759516	
73	16:13430	OSTI; NTIS (US Sales Only); INIS		DE91754872	
74	16:13431	OSTI; NTIS (US Sales Only)		DE91754803	
75	16:13432	OSTI; NTIS (US Sales Only)		DE91759563	
KFKI–					
1990-27/C	16:13598	OSTI; NTIS (US Sales Only)		DE91009149	
KTM/E-D–					
185	16:12363	OSTI; NTIS (US Sales Only)		DE91752992	
187	16:12594	OSTI; NTIS (US Sales Only)		DE91752999	
LA–					
11594-MS	16:12509	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008161	MF-814
11773-MS	16:13406	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009009	PC-910; PC-700
11781-MS	16:13407	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008997	PC-700
11825-MS	16:13408	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009228	PC-700
11829-MS	16:13409	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009000	PC-700
11830-MS	16:13410	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009045	PC-700
11847-MS	16:13411	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009229	MF-900
11859-MS	16:13412	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008999	PC-700
11870-MS	16:13357	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009004	MF-700; MF-900
11919-MS	16:13358	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009002	PC-700; PC-900
11920-MS	16:13413	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008480	PC-700; PC-900
11943-MS	16:13213	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007863	
11948-MS	16:13568	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008482	PC-707
11959-MS	16:13405	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008483	PC-700; PC-900
11966-M	16:13907	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009846	PC-705
11974-MS	16:13414	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008481	PC-700; PC-900
12000-ENV	16:13433	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009003	PC-702; PC-707
12004-C	16:13260	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009298	MF-414; MF-910
12013-MS	16:13415	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009219	PC-700; PC-900

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
12020	16:13760	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008497	MF-700; MF-706
12029	16:13326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009227	PC-906
12058-MS	16:13359	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009005	MF-900
LA-UR–					
90-2996	16:13664	*See* DOE/ER/40423–15			
90-3726	16:13908	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004823	MF-905
91-133	16:12857	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007390	MF-520
91-147	16:13191	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007391	MF-901
91-334	16:13909	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007481	MF-905
91-339	16:13327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008578	MF-406; MF-410
91-361	16:13527	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007484	MF-901
91-409	16:13176	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007494	MF-901
91-434	16:13158	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008579	
91-437	16:13738	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008580	MF-413
91-468	16:13749	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008582	MF-907
91-510	16:13528	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008585	MF-408
91-514	16:13696	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008586	MF-413
91-532	16:13298	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008587	
91-562	16:13529	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008591	MF-408
91-567	16:13762	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008592	MF-910
91-589	16:13615	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008593	MF-405
91-610	16:13059	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008595	MF-904
91-618	16:13599	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008596	MF-910
91-631	16:13846	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008598	MF-910
91-633	16:13768	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008599	MF-414
91-638	16:13478	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008600	MF-903
91-662	16:13683	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008604	MF-414
91-678	16:13910	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008605	
91-728	16:13847	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008607	MF-712
91-729	16:13911	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008608	MF-905
91-786	16:13700	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009942	MF-700
LAL–					
9035	16:13635	OSTI; NTIS (US Sales Only)		DE91757079	
LBL–					
28452	16:12937	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009079	MF-350
28685	16:13761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009329	MF-411
28729	16:13265	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009739	MF-406
29055	16:13328	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009095	MF-406
29057	16:13329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009078	MF-413
29232	16:13266	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009674	MF-414
29233	16:13274	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009740	MF-414
29335	16:13660	*See* DOE/ER/40224–155			
29470	16:13620	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008218	MF-405
29578-Rev.	16:13716	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009087	MF-413
29614	16:13060	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009074	MF-404
29622	16:13299	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009094	MF-414
29682	16:12510	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009332	MF-802; MF-403
29703	16:12511	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008919	MF-403
29780	16:13676	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009114	MF-413
29793	16:13717	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009072	MF-413
29815	16:13192	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009738	MF-401
29822	16:13300	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009081	MF-414
29823	16:13303	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009073	MF-414
29840	16:13061	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009090	MF-404
29843	16:13099	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009112	MF-404
29845	16:13181	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009315	MF-401
29867	16:12512	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009096	MF-814
29875	16:13177	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009741	MF-401
29883	16:13178	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008928	MF-401
29888	16:13123	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008927	MF-404
29924	16:13062	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009083	MF-215
29957	16:13267	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009327	MF-414
29960	16:13063	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009113	MF-404
30081	16:13349	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009331	MF-403
30110	16:13912	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007697	MF-405
30129	16:13739	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009326	MF-413
30132	16:12876	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009093	MF-215
30144	16:13636	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009737	MF-414

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30146	16:12513	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009092	MF-814
30158	16:13540	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009091	MF-408
30181	16:12514	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009080	MF-403
30222	16:13330	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009773	MF-406
30292	16:13331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009082	MF-406
LBL-PUB–					
496-No.6	16:13268	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009077	MF-414
679	16:12872	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009075	MF-400
LIU-TEK-LIC–					
90-45	16:13064	OSTI; NTIS (US Sales Only)		DE91753042	
LPCC–					
8901	16:13710	OSTI; NTIS (US Sales Only)		DE91752693	
8903	16:13718	OSTI; NTIS (US Sales Only)		DE91752694	
8904	16:13719	OSTI; NTIS (US Sales Only)		DE91752695	
8907	16:13703	OSTI; NTIS (US Sales Only)		DE91752696	
9001	16:13720	OSTI; NTIS (US Sales Only)		DE91752691	
9002	16:13721	OSTI; NTIS (US Sales Only)		DE91752692	
9003	16:13704	OSTI; NTIS (US Sales Only)		TI91757082	
9004	16:13705	OSTI; NTIS (US Sales Only)		DE91757087	
LPCCT–					
9001	16:13913	OSTI; NTIS (US Sales Only)		DE91757086	
LPNHEP–					
9002	16:13304	OSTI; NTIS (US Sales Only)		DE91752703	
LRP–					
382/89	16:13800	OSTI; NTIS (US Sales Only); INIS		DE91623014	
398/90	16:13801	OSTI; NTIS (US Sales Only); INIS		DE91623015	
411/90	16:13802	OSTI; NTIS (US Sales Only); INIS		DE91003074	
415/90	16:13806	OSTI; NTIS (US Sales Only); INIS		DE91622078	
420/90	16:13807	OSTI; NTIS (US Sales Only); INIS		DE91623017	
421/90	16:13808	OSTI; NTIS (US Sales Only); INIS		DE91623018	
424/90	16:13609	OSTI; NTIS (US Sales Only); INIS		DE91622984	
425/90	16:13914	OSTI; NTIS (US Sales Only); INIS		DE91623476	
LUNBDS-NBBE–					
90-1035	16:13479	OSTI; NTIS (US Sales Only)		DE91753017	
LUNBDS-NBLI–					
90-1020-112	16:13510	OSTI; NTIS (US Sales Only); INIS		DE91623330	
LUTKDH-TKKT–					
1012-1-110-90	16:13514	OSTI; NTIS (US Sales Only)		DE91753029	
LUTMDN-TMVK–					
1007-1-139-90	16:12878	OSTI; NTIS (US Sales Only)		DE91753031	
MEA–					
2221	16:13065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009373	MF-704
87-05	16:13065	*See* MEA–2221			
MLM–					
3677	16:12891	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007664	PC-515
MPI-PAE/Exp.El.–					
232	16:13637	OSTI; NTIS (US Sales Only); INIS		DE91756211	
NASA-CR–					
187039	16:13017	*See* DOE/NASA–0336-2			
NBL–					
323	16:13159	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009061	MF-940
NDRL–					
3345	16:13184	*See* DOE/ER/00038–3345			
NEACRP-A–					
995.	16:13724	*See* AEEW-R–2591			
NEANDC-E–					
312	16:13870	*See* EUR–12822			
NEI-DK–					
480	16:13003	OSTI; NTIS (US Sales Only)		DE91752939	
481	16:12938	OSTI; NTIS (US Sales Only)		DE91752940	
482	16:12886	OSTI; NTIS (US Sales Only)		DE91752941	
483	16:12608	OSTI; NTIS (US Sales Only)		DE91752942	
484	16:12887	OSTI; NTIS (US Sales Only)		DE91752945	
485	16:12631	OSTI; NTIS (US Sales Only)		DE91752946	
486	16:12632	OSTI; NTIS (US Sales Only)		DE91752947	
487	16:12877	OSTI; NTIS (US Sales Only)		DE91752948	
488	16:12611	OSTI; NTIS (US Sales Only)		DE91752949	
489	16:12909	OSTI; NTIS (US Sales Only)		DE91752950	
490	16:12586	OSTI; NTIS (US Sales Only)		DE91752951	
491	16:12600	OSTI; NTIS (US Sales Only)		DE91752954	
492	16:12939	OSTI; NTIS (US Sales Only)		DE91752955	

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493	16:13480	OSTI; NTIS (US Sales Only)		DE91752956	
494	16:12649	OSTI; NTIS (US Sales Only)		DE91752957	
NEI-FI–					
127	16:12412	OSTI; NTIS (US Sales Only)		DE91752997	
NEI-NO–					
115	16:12401	OSTI; NTIS (US Sales Only)		DE91746289	
116	16:12940	OSTI; NTIS (US Sales Only)		DE91746290	
NIKHEF-H–					
90-13	16:13332	OSTI; NTIS (US Sales Only); INIS		DE91622816	
90-15	16:13685	OSTI; NTIS (US Sales Only); INIS		DE91623477	
NILU-OR–					
31/89	16:13434	OSTI; NTIS (US Sales Only)		DE91753008	
53/89	16:13435	OSTI; NTIS (US Sales Only)		DE91753012	
63/89	16:13436	OSTI; NTIS (US Sales Only)		DE91753010	
79/89	16:13437	OSTI; NTIS (US Sales Only)		DE91753003	
NIPER–					
488	16:13124	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002225	PC-122
522-Vol.2	16:12402	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008824	MF-122
NIRS–					
28	16:13871	OSTI; NTIS (US Sales Only); INIS		DE91755688	
NIRS-M–					
75	16:13546	OSTI; NTIS (US Sales Only); INIS		DE91755667	
76	16:13750	OSTI; NTIS (US Sales Only); INIS		DE91755683	
NIRS-R–					
19	16:13547	OSTI; NTIS (US Sales Only); INIS		DE91755668	
NORD–					
90-22	16:13438	OSTI; NTIS (US Sales Only)		DE91753038	
NSF-ITP–					
90-147	16:13641	*See* BNL–45157			
90-204	16:13667	*See* DOE/ER/40423–20			
90-205	16:13668	*See* DOE/ER/40423–21			
90-206	16:13664	*See* DOE/ER/40423–15			
NUHEP-TH–					
90-12	16:13655	*See* DOE/ER/40224–149			
NUREG–					
0386-Digest5-Rev.9	16:12892	OSTI; NTIS; INIS; GPO		TI91008975	
0540-Vol.12-No.12	16:12791	OSTI; NTIS; INIS; GPO		TI91008181	
0750-Vol.32-No.6	16:12792	OSTI; NTIS; INIS; GPO		TI91008154	
1214-Rev.7	16:12858	OSTI; NTIS; INIS; GPO		TI91008597	
1275-Vol.6	16:12859	OSTI; NTIS; INIS; GPO		TI91008182	
1391	16:13576	OSTI; NTIS; INIS; GPO		TI91008558	
1397	16:12860	OSTI; NTIS; INIS; GPO		TI91008557	
NUREG/CP–					
0037	16:12861	OSTI; NTIS; INIS; GPO		TI91008490	
0115	16:12862	OSTI; NTIS; INIS		TI91008351	
NUREG/CR–					
4295	16:12515	OSTI; NTIS; GPO; INIS		TI91009035	
4670	16:12516	OSTI; NTIS; INIS; GPO		TI91008555	
4911	16:12863	OSTI; NTIS; INIS; GPO		TI91008191	
5288	16:12864	OSTI; NTIS; INIS; GPO		TI91008079	
5312	16:12756	OSTI; NTIS; INIS; GPO		TI91008559	
5432-Vol.1	16:12517	OSTI; NTIS; INIS; GPO		TI91009084	
5432-Vol.2	16:12518	OSTI; NTIS; INIS; GPO		TI91009085	
5432-Vol.3	16:12519	OSTI; NTIS; INIS; GPO		TI91009086	
5536	16:13439	OSTI; NTIS; INIS; GPO		TI91008556	
5618	16:12520	OSTI; NTIS; INIS; GPO		TI91008491	
5665	16:12865	OSTI; NTIS; INIS; GPO		TI91008560	
5667	16:12866	OSTI; NTIS; INIS; GPO		TI91009217	
5672-Vol.1	16:12521	OSTI; NTIS; INIS; GPO		TI91008189	
NWPO-SE–					
035-90	16:12476	*See* DOE/NV/10461–T42			
OCS/EIS/EA/MMS–					
90-0009	16:13515	OSTI; Library/Public information Room, MMS, Alaska OCS Region, 949 East 36th Avenue, Room 110, Anchorage, AK 99508-4302		TI91008930	
OEFZS–					
4562	16:13481	OSTI; NTIS (US Sales Only); INIS		DE91622595	
OITS–					
422	16:13649	*See* DOE/ER/40224–136			
429	16:13650	*See* DOE/ER/40224–139			
431	16:13651	*See* DOE/ER/40224–141			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
433-R	16:13652	*See* DOE/ER/40224–143			
434	16:13653	*See* DOE/ER/40224–144			
435	16:13674	*See* DOE/ER/40224–145			
436	16:13654	*See* DOE/ER/40224–146			
438	16:13675	*See* DOE/ER/40224–148			
439	16:13655	*See* DOE/ER/40224–149			
440	16:13656	*See* DOE/ER/40224–150			
441	16:13657	*See* DOE/ER/40224–151			
442	16:13658	*See* DOE/ER/40224–152			
443	16:13659	*See* DOE/ER/40224–153			
445	16:13660	*See* DOE/ER/40224–155			
446	16:13661	*See* DOE/ER/40224–156			
447	16:13662	*See* DOE/ER/40224–157			
ORNL–					
6609	16:13931	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004981	
ORNL/CSD/TM–					
277	16:13915	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008915	MF-405
ORNL/FTR–					
3864	16:12867	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007816	MF-500
3865	16:13848	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008550	MF-423
3866	16:12839	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008805	MF-500
3867	16:13440	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009110	MF-402
3868	16:13516	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008913	MF-402
ORNL/M–					
1040	16:13549	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008806	
1154	16:13517	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008552	MF-402
1155	16:13441	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009194	MF-407
1165	16:12318	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008914	MF-114
1179	16:12522	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008818	MF-721
1351	16:13202	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007886	MF-406
ORNL/RASA–					
89/19	16:13482	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008819	MF-511
ORNL/Sub–					
89-SA187/01	16:13066	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008551	MF-114
ORNL/TM–					
10846/R1	16:13872	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008075	MF-610
11467	16:12431	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009046	MF-630
11735	16:13100	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007821	MF-332
11744	16:13916	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009222	MF-405
11748	16:13333	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008113	MF-406
11763	16:13695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008631	MF-413
11768	16:13917	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009221	MF-405
ORNL/TR–					
90/28	16:13741	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008916	MF-507
90/29	16:13751	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008917	MF-507
OY/PSTL-RR–					
100	16:12373	OSTI; NTIS (US Sales Only)		DE91752966	
102	16:12364	OSTI; NTIS (US Sales Only)		DE91752967	
PARAMETER/IE–					
164	16:12864	*See* NUREG/CR–5288			
PATENTS–					
	16:13106	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
PCCF-T–					
9001	16:13638	OSTI; NTIS (US Sales Only)		DE91757085	
9002	16:13334	OSTI; NTIS (US Sales Only)		DE91757084	
PNL–					
7329	16:12888	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005620	
7375	16:13932	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008190	MF-505; MF-502
7566	16:13518	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008817	MF-403
7583	16:13483	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008205	MF-702
7590-Vol.1	16:13012	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008602	MF-350
7596	16:12863	*See* NUREG/CR–4911			
7599	16:12523	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009186	MF-940
7602	16:12524	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009103	MF-940
7618	16:13484	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009248	
7624	16:13179	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008429	MF-401

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PNL-SA–					
18545	16:13125	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009106	MF-404
18586	16:13126	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009040	MF-404
18587	16:13127	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009042	MF-404
18588	16:13101	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008829	MF-404
18592	16:12525	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008747	MF-721
18622	16:13128	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008828	MF-404
18628	16:12526	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008743	MF-510
18646	16:13752	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008827	
18728	16:13024	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008750	MF-500
18821	16:13214	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007900	MF-506; MF-510
18847	16:13139	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009116	MF-405
18882	16:12562	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008207	MF-510; MF-505
18892	16:13569	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008258	MF-510
18904	16:13849	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009368	MF-420
18908	16:13102	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009105	MF-504
18980	16:12527	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008744	MF-511
18998	16:12563	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008748	MF-510
18999	16:12465	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008746	MF-513
19002	16:12564	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008745	MF-511
19014	16:13485	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008749	MF-510
19026	16:13918	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008261	MF-510
19148	16:12884	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008260	MF-510
POEF-T–					
3537	16:12528	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007465	MF-517
PPPL–					
2735	16:13610	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010011	PC-426
PSI–					
1024	16:12393	*See* DOE/PC/90751–T6			
1024	16:12394	*See* DOE/PC/90751–T7			
71	16:12757	OSTI; NTIS (US Sales Only); INIS		DE91003073	
79	16:13231	OSTI; NTIS (US Sales Only); INIS		DE91622707	
81	16:13850	OSTI; NTIS (US Sales Only); INIS		DE91622101	
83	16:13486	OSTI; NTIS (US Sales Only); INIS		DE91622525	
85	16:13753	OSTI; NTIS (US Sales Only); INIS		DE91623390	
87	16:12868	OSTI; NTIS (US Sales Only); INIS		DE91623400	
88	16:13180	OSTI; NTIS (US Sales Only); INIS		DE91623216	
PWA–					
34/90	16:13155	*See* KFK–4775			
36/90	16:13325	*See* KFK–4784			
RD–					
2	16:12936	*See* GB–314			
3	16:12935	*See* GB–313			
6	16:12970	*See* GB–303			
9	16:12933	*See* GB–290			
11	16:12975	*See* GB–309			
12	16:12976	*See* GB–310			
13	16:12971	*See* GB–304			
14	16:12974	*See* GB–308			
20/27	16:12977	*See* GB–311			
21/28	16:12972	*See* GB–305			
22/29	16:12973	*See* GB–306			
31/8	16:12934	*See* GB–307			
47/61	16:12978	*See* GB–312			
RERF-TR–					
0-88	16:13570	OSTI; NTIS (US Sales Only); INIS		DE91755689	
RSI–					
0357	16:12534	*See* SAND–90-7009			
RT-DSD–					
09	16:13160	OSTI; NTIS (US Sales Only)		DE91752688	
RT/AMB–					
90-09	16:13556	*See* ENEA-RT-AMB–90-09			
90-13	16:12647	*See* ENEA-RT-AMB–90-13			
90-14	16:13149	*See* ENEA-RT-AMB–90-14			
90-19	16:13505	*See* ENEA-RT-AMB–90-19			
RT/DISP–					
90-01	16:13424	*See* ENEA-RT-DISP–90-01			
RT/ENERG–					
90-02	16:13118	*See* ENEA-RT-ENERG–90-02			

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RT/FUS–					
89-14	16:13778	*See* ENEA-RT-FUS–89-14			
89-15	16:13779	*See* ENEA-RT-FUS–89-15			
89-26	16:13780	*See* ENEA-RT-FUS–89-26			
89-27	16:13781	*See* ENEA-RT-FUS–89-27			
RT/INN–					
90-01	16:13614	*See* ENEA-RT-INN–90-01			
90-08	16:13045	*See* ENEA-RT-INN–90-08			
90-10	16:13150	*See* ENEA-RT-INN–90-10			
90-11	16:13046	*See* ENEA-RT-INN–90-11			
90-13	16:12885	*See* ENEA-RT-INN–90-13			
RT/TIB–					
89-68	16:13119	*See* ENEA-RT-TIB–89-68			
89-70	16:13120	*See* ENEA-RT-TIB–89-70			
89-71	16:13245	*See* ENEA-RT-TIB–89-71			
89-74	16:13246	*See* ENEA-RT-TIB–89-74			
89-75	16:13121	*See* ENEA-RT-TIB–89-75			
89-78	16:13095	*See* ENEA-RT-TIB–89-78			
RU–					
90-40	16:13645	*See* DESY–90-099			
S–					
59/85	16:12962	*See* GB–293			
SAND–					
86-2742	16:13416	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008008	PC-700
88-3324	16:12756	*See* NUREG/CR–5312			
89-1023	16:13129	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009101	MF-501
89-2869C	16:13103	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009256	MF-704
89-7006-Vol.1	16:12529	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008314	MF-814
89-7006-Vol.2	16:12530	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008315	MF-814
90-0102	16:13215	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009183	MF-505
90-0191C	16:12399	OSTI; NTIS; GPO Dep.	E 1.99:	DE91000407	MF-126
90-0610	16:13360	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009006	MF-706
90-1691	16:13364	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009100	MF-741
90-1706C	16:13919	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009038	MF-405
90-1742C	16:13216	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005865	MF-721
90-1851C	16:13200	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009167	MF-741
90-2089	16:12520	*See* NUREG/CR–5618			
90-2124C	16:13217	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007573	MF-700
90-2158C	16:13218	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007509	MF-706
90-2219C	16:13219	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009169	MF-705
90-2250C	16:13193	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007069	MF-722
90-2260	16:12633	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009182	MF-261
90-2308C	16:13104	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008577	MF-401
90-2336C	16:13920	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004503	MF-705
90-2342C	16:12531	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007570	MF-721
90-2437C	16:13742	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009170	MF-706
90-2519	16:13352	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009099	MF-706
90-2526C	16:13220	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007730	MF-722
90-2527C	16:13221	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008256	MF-721
90-2540C	16:13130	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008183	MF-704
90-2550C	16:13921	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008171	MF-705
90-2552	16:13250	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009226	MF-410
90-2656C	16:13616	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009473	MF-706
90-2737	16:13769	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009224	MF-705
90-2797	16:12862	*See* NUREG/CP–0115			
90-2817C	16:12532	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91005315	MF-814
90-2848	16:12533	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009185	MF-721
90-2993	16:13873	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008072	MF-900
90-2998C	16:13251	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005236	MF-706
90-3090C	16:13161	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007517	MF-704
90-3122	16:13252	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009225	MF-410
90-3143C	16:13067	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005312	MF-704
90-7009	16:12534	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007251	MF-721
90-7015	16:13439	*See* NUREG/CR–5536			
90-7035	16:13068	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009102	MF-274
90-8254	16:13865	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008124	MF-700
91-0011C	16:13069	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006967	MF-704
91-0169	16:13105	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009223	MF-400
91-0187C	16:12819	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009174	
91-0190C	16:12566	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008254	MF-700
91-0232C	16:13131	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007571	MF-704

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91-0292C	16:13132	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008180	MF-704
91-0324C	16:12595	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009176	MF-702; MF-706
91-0325C	16:12567	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008576	MF-706
91-0327C	16:13353	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008257	MF-706
91-0400C	16:13236	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008252	MF-706
91-0401C	16:13922	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008574	MF-706; MF-705
91-0412C	16:13253	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008198	MF-706
91-0420C	16:13222	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008173	MF-700
91-0470C	16:13223	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008253	MF-706
91-0505C	16:13070	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009189	MF-404; MF-406
91-0517C	16:13933	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009191	MF-705
92-0402C	16:13923	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009175	MF-706; MF-704
SB-UB–					
90-38	16:12588	OSTI; NTIS (US Sales Only)		DE91753035	
90-39	16:13442	OSTI; NTIS (US Sales Only)		DE91753033	
SB-US–					
90-41	16:13013	OSTI; NTIS (US Sales Only)		DE91753037	
SERI/CP–					
213-4079	16:12603	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002120	MF-270
SFB-191–					
90-A1-001	16:13809	OSTI; NTIS (US Sales Only); INIS		DE91754663	
SI–					
14940000-1	16:12865	*See* NUREG/CR–5665			
SIEMENS-KWU-B–					
313-90/e148	16:12824	OSTI; NTIS (US Sales Only); INIS		DE91756650	
33/90/0808	16:12661	OSTI; NTIS (US Sales Only); INIS		DE91754712	
SIEMENS-KWU-E–					
331-90/002	16:12427	OSTI; NTIS (US Sales Only)		DE91756651	
331/90/001	16:12639	OSTI; NTIS (US Sales Only)		DE91754799	
SIEMENS-KWU-TWC–					
2244/88	16:13071	OSTI; NTIS (US Sales Only); INIS		DE91754622	
2246/88	16:13072	OSTI; NTIS (US Sales Only); INIS		DE91754620	
SIEMENS-KWU-TWM–					
0405/89	16:13073	OSTI; NTIS (US Sales Only); INIS		DE91754621	
1116/89	16:13074	OSTI; NTIS (US Sales Only); INIS		DE91754713	
1339/89	16:13075	OSTI; NTIS (US Sales Only); INIS		DE91759512	
2429/88	16:13076	OSTI; NTIS (US Sales Only); INIS		DE91754623	
SLAC-ABC–					
24	16:13275	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008536	MF-414
SLAC-PUB–					
5347	16:13269	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009361	MF-414
5365-Rev.	16:13335	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009365	MF-414
5419	16:13673	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008496	MF-414
5428	16:13639	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009366	MF-414
5436	16:13276	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009367	MF-414
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91-1	16:13924	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008518	MF-405
SLU-LBT–					
69	16:12599	OSTI; NTIS (US Sales Only)		DE91753026	
SP–					
90-19	16:12941	OSTI; NTIS (US Sales Only)		DE91753028	
SR/NES–					
90-02	16:12897	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009200	MF-950
90-04	16:12910	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009202	MF-950
SSCL-SR–					
1146	16:13336	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009742	PC-400
STF–					
11A90013	16:12895	OSTI; NTIS (US Sales Only)		DE91753002	
11A90024	16:12942	OSTI; NTIS (US Sales Only)		DE91753009	
20A90035	16:13241	OSTI; NTIS (US Sales Only)		DE91753006	
20A90036	16:13242	OSTI; NTIS (US Sales Only)		DE91753007	
21A90049	16:12414	OSTI; NTIS (US Sales Only)		DE91753011	
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85-3348	16:12319	OSTI; NTIS (US Sales Only)		DE91753023	
89-1266	16:13004	OSTI; NTIS (US Sales Only)		DE91753040	
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89-15	16:13015	*See* SVF–365			

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90-16	16:13133	*See* SVF–380			
STUDSVIK-NI–					
89-26	16:13240	*See* SVF–385			
STUDSVIK-NS–					
89-74	16:12640	*See* SVF–366			
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90-5	16:12662	OSTI; NTIS (US Sales Only); INIS		DE91623404	
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90-35	16:13445	OSTI; NTIS (US Sales Only)		DE91753024	
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364	16:13014	OSTI; NTIS (US Sales Only)		DE91753051	
365	16:13015	OSTI; NTIS (US Sales Only)		DE91753052	
366	16:12640	OSTI; NTIS (US Sales Only)		DE91753054	
367	16:12641	OSTI; NTIS (US Sales Only)		DE91753044	
368	16:12650	OSTI; NTIS (US Sales Only)		DE91753045	
369	16:12415	OSTI; NTIS (US Sales Only)		DE91753056	
370	16:12591	OSTI; NTIS (US Sales Only)		DE91753057	
371	16:12359	OSTI; NTIS (US Sales Only)		DE91753047	
372	16:12358	OSTI; NTIS (US Sales Only)		DE91753077	
373	16:13443	OSTI; NTIS (US Sales Only)		DE91753079	
376	16:13077	OSTI; NTIS (US Sales Only)		DE91753059	
378	16:12584	OSTI; NTIS (US Sales Only)		DE91753081	
380	16:13133	OSTI; NTIS (US Sales Only)		DE91753061	
384	16:13444	OSTI; NTIS (US Sales Only)		DE91753063	
385	16:13240	OSTI; NTIS (US Sales Only)		DE91753082	
386	16:12651	OSTI; NTIS (US Sales Only)		DE91753049	
387	16:12585	OSTI; NTIS (US Sales Only)		DE91753064	
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1027	16:12393	*See* DOE/PC/90751–T6			
1027	16:12394	*See* DOE/PC/90751–T7			
82/14	16:12679	*See* DOE/NE/34082–T19			
82/15	16:12678	*See* DOE/NE/34082–T18			
83/21	16:12684	*See* DOE/NE/34082–T28			
83/22	16:12680	*See* DOE/NE/34082–T21			
84/25B	16:12675	*See* DOE/NE/34082–T13			
84/26	16:12676	*See* DOE/NE/34082–T14			
84/27	16:12677	*See* DOE/NE/34082–T15			
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89/83	16:12686	*See* DOE/NE/34082–T31			
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90/37	16:13620	*See* LBL–29470			
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90/67	16:13810	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008959	MF-427
UCID–					
21798	16:13027	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008424	MF-705
21868	16:13028	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008423	MF-705
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34P278-75	16:13530	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009146	MF-408

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102799	16:13487	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008457	MF-702; MF-707
21001-90-2	16:13577	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008445	
52000-90-11-12	16:13337	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008244	PC-700
UCRL-CR–					
104696	16:13611	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008444	
105858-Summ.	16:13134	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008563	MF-701
105908	16:13851	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008566	MF-700
106131	16:13343	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008601	MF-702
UCRL-ID–					
104094	16:13346	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009716	MF-706
104566	16:13811	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008628	MF-420
104929	16:13237	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008994	MF-704
105300	16:13361	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009008	MF-700
105489	16:13362	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008073	
105872	16:13617	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008627	MF-706
105975	16:13363	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009007	MF-700
106142	16:13078	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008626	MF-704
106454-90-4	16:12893	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007637	MF-700
106505	16:12429	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007996	MF-706; MF-701
106509	16:13224	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008426	
106603	16:13812	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009502	MF-420
UCRL-JC–					
103740	16:13135	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008501	MF-701
103816-Rev.1	16:13852	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008736	MF-712
104229	16:13531	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008732	MF-708
104365	16:13853	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009477	MF-712
104394	16:13254	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008990	MF-712
104407-Rev.1	16:13255	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007146	MF-706
104591	16:13079	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008506	MF-701
104594	16:13080	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008570	MF-404
104768	16:13338	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008085	MF-802
104810	16:13578	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008991	MF-408
104826	16:13225	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008456	MF-705
104984-R1	16:13854	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009479	MF-712
105017	16:13925	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007124	MF-705
105123	16:13855	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009483	MF-705; MF-713
105124	16:13813	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009482	MF-700
105237	16:13339	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008454	MF-705; MF-706
105344	16:13856	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009752	MF-706
105356	16:13354	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005061	MF-700
105391	16:13519	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008453	MF-706; MF-721
105417	16:12417	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008446	MF-203
105424	16:13256	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005059	MF-506; MF-501
105541	16:13257	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007346	MF-713
105542	16:13743	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008503	MF-731
105613	16:13258	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008064	MF-706
105616	16:13814	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009750	MF-705
105645	16:13340	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008739	MF-700
105646	16:13341	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008738	MF-700
105655	16:13259	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008455	MF-706
105733	16:13857	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008729	MF-712
105782	16:12565	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007614	MF-706
105791	16:13926	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007635	MF-705
105829	16:13815	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009478	MF-700
105830	16:13858	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008742	MF-712
105962	16:13927	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007259	MF-700
105984	16:13347	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007128	
105999	16:13600	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008062	MF-700
106127	16:13136	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008505	MF-701; MF-704
106136	16:13081	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008731	MF-404
106151	16:13082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008572	MF-404
106152	16:13083	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008571	MF-404

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106161	16:12537	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008733	MF-814
106275	16:13859	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008735	MF-712
106277	16:13860	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008734	MF-700
106408	16:13816	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008741	MF-705
106422	16:13601	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009736	MF-420
106511	16:13162	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008989	MF-704
106518	16:13137	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008569	MF-706
106520	16:13138	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008500	MF-704
106737	16:13861	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009475	MF-713
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104538	16:13194	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008119	PC-700
105199	16:13446	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009070	PC-400; PC-600; PC-700
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105268	16:13226	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009759	MF-705
105607	16:13447	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008443	MF-402; MF-405
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1990-38	16:13686	OSTI; NTIS (US Sales Only); INIS		DE91621761	
1990-39	16:13687	OSTI; NTIS (US Sales Only); INIS		DE91621762	
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21	16:12369	OSTI; NTIS (US Sales Only)		DE91752989	
22	16:12370	OSTI; NTIS (US Sales Only)		DE91752998	
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1187	16:13023	OSTI; NTIS (US Sales Only)		DE91752990	
1190	16:12652	OSTI; NTIS (US Sales Only)		DE91752994	
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20009	16:12943	OSTI; NTIS (US Sales Only)		DE91752988	
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8903-V/5	16:13022	OSTI; NTIS (US Sales Only)		DE91754897	
WHC-EP–					
0063-2	16:12538	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009164	MF-900
0165-2	16:13448	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009160	MF-721
0182-28	16:12539	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009161	MF-900
0182-29	16:12540	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009159	MF-900
0182-30	16:12541	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009347	MF-900
0182-31	16:12542	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009348	MF-900
0182-32	16:12543	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009349	MF-900
0258-1	16:13449	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009158	MF-703
0294	16:12544	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009163	MF-900
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0222	16:12556	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007170	MF-902
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1000	16:12546	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009215	MF-902
1068	16:13862	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007958	MF-404
1120	16:12547	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009420	MF-402
1123	16:12548	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009313	MF-402
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1081	16:12455	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007584	PC-510
1082	16:13355	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007909	PC-510
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90-274	16:12550	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009319	MF-721
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90-341	16:12825	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009293	MF-705
WSRC-RP–					
89-1315	16:12569	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007926	MF-701
89-1390	16:12871	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007959	MF-706
90-1209	16:13450	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009305	MF-702; MF-721

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90-778	16:13520	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007196	MF-702
WSRC-TR–					
90-14	16:12826	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007902	MF-706
90-391	16:12551	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009297	PC-705
90-526-Rev.1	16:12552	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009291	PC-701
90-527-Rev.1	16:12553	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009295	PC-701
90-528-Rev.1	16:12554	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009296	PC-701
90-539-Rev.1	16:12555	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009294	PC-701
Windscale-Trans–					
1184	16:13195	OSTI; NTIS (US Sales Only); INIS		DE91623343	
Y/DZ–					
709	16:12446	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009195	MF-704
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91-YP507C/2-Pt.1	16:13521	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009197	MF-702
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91-TJ997C/4	16:13488	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009196	MF-702

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UG Uganda
US United States of America (USA)
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